Table 2.3 Irrigation Water Requirement in Ncoha II Project (1/4)

Site : Ncoha-II
Crops : Wet Season Paddy

Item		Month	Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul		Aug.		Sep.		Oct.		Nov.		Dec.		Annual
		(days)	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
			15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)		mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
		mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Wet Season Paddy																											
(1) Proposed cropping pattern / Crop coefficient																											
- WP-1			1.10	1.10	1.05	1.05	0.95	0.00																	LP	LP	
- WP-2			LP	1.10	1.10	1.05	1.05	0.95	0.00																	LP	
- WP-3			LP	LP	1.10	1.10	1.05	1.05	0.95	0.00																	
(2) Crop consumptive use (Etc)																											
- WP-1		mm	69	74	62	62	62	0																			329
- WP-2		mm		74	65	62	69	66	0																		335
- WP-3		mm			65	65	69	73	63	0																	334
(3) Land preparation (IR)																											
- WP-1		mm																							183	195	378
- WP-2		mm	182																							195	377
- WP-3		mm	182	194																							376
(4) Percolation																											
- WP-1		mm	30	32	28	28	30																				
- WP-2		mm		32	28	28	30	32																			
- WP-3		mm			28	28	30	32	30																		
(5) Water layer replacement (RW)																											
- WP-1		mm		50		50																					
- WP-2		mm			50		50																				
- WP-3		mm				50		50																			
(6) Effective rainfall (ER)		mm	64	68	60	60	42	45	19	19	8	8	5	4	1	2	0	1	2	3	9	10	35	35	56	60	616
(7) Field water requirement																											
- WP-1		mm	35	88	30	80	50	0																	127	135	545
- WP-2		mm	118	38	83	30	107	53	0																	135	563
- WP-3		mm	118	126	33	83	57	110	74	0																	600
(8) Diversion requirement		mm	139	129	74	99	109	84	38	0															65	138	876
		m3/ha	1,390	1,290	740	990	1,090	840	380	0															650	1,380	8,750

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 2.3 Irrigation Water Requirement in Ncoha II Project (2/4)

Site : Ncoha-II
Crops : Dry Season Paddy

Item		Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2	May 1	May 2	Jun. 1	Jun. 2	Jul 1	Jul 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Annual
	Month (days)	15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)	mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
	mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Dry Season Paddy																										
(1) Proposed cropping pattern / Crop coefficient																										
- DP-1								LP	LP	1.10	1.10	1.05	1.05	0.95	0.00											
- DP-2										LP	LP	1.10	1.10	1.05	1.05	0.95	0.00									
- DP-3											LP	LP	1.10	1.10	1.05	1.05	0.95	0.00								
(2) Crop consumptive use (Etc)																										
- DP-1	mm										74	66	63	68	65	0										335
- DP-2	mm											66	66	68	72	69	0									341
- DP-3	mm												66	71	72	77	74	0								359
(3) Land preparation (IR)																										
- DP-1	mm								183	182																365
- DP-2	mm									182	194															376
- DP-3	mm										194	179														373
(4) Percolation																										
- DP-1	mm										32	30	30	30	32	0										
- DP-2	mm											30	30	30	32	30	0									
- DP-3	mm												30	30	32	30	32	0								
(5) Water layer replacement (RW)																										
- DP-1	mm											50		50												
- DP-2	mm												50		50											
- DP-3	mm													50		50										
(6) Effective rainfall (ER)	mm	64	68	60	60	42	45	19	19	8	8	5	4	1	2	0	1	2	3	9	10	35	35	56	60	616
(7) Field water requirement																										
- DP-1	mm								164	174	98	141	89	147	145	0										957
- DP-2	mm									174	186	91	142	97	152	99	0									941
- DP-3	mm										186	174	92	150	102	157	105	0								965
(8) Diversion requirement	mm								84	178	241	208	165	201	205	131	54	0								1,468
	m3/ha								840	1,780	2,410	2,080	1,650	2,010	2,050	1,310	540	0								14,670

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 2.3 Irrigation Water Requirement in Ncoha II Project (3/4)

Site : Ncoha-II
Crops : Palawija (1/2) : Mungbeans and Red onion

Item		Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2	May 1	May 2	Jun. 1	Jun. 2	Jul 1	Jul 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Annual
	Month (days)	15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)	mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
	mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Palawija(1), (2) : Mungbeans and Red onion																										
(1) Proposed cropping pattern / Crop coefficient(Kc)								**Mungbeans**										**Red onion**								
- Pwj(1),(2)-1								0.45	0.75	1.05	0.30							0.50	0.60	0.95	0.75					
- Pwj(1),(2)-2									0.45	0.75	1.05	0.30							0.50	0.60	0.95	0.75				
- Pwj(1),(2)-3										0.45	0.75	1.05	0.30							0.50	0.60	0.95	0.75			
(2) Crop consumptive use(Etc)																										
- Pwj(1),(2)-1	mm							30	47	70	18							41		51	86	58				
- Pwj(1),(2)-2	mm								28	50	63	18								43	55	74	58			
- Pwj(1),(2)-3	mm									30	45	63	19								45	47	74	50		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(1),(2)-1	mm							10	38	61	13							41		40	74	21				299
- Pwj(1),(2)-2	mm								19	41	58	13								32	43	37	20			262
- Pwj(1),(2)-3	mm									21	40	58	19								33	10	36	0		217
(5) Diversion requirement	mm							7	38	83	74	47	13					27		48	100	45	37	0		519
	m3/ha							70	380	830	740	470	130					270		480	1,000	450	370	0		5,190
III. Palawija (3) : Mungbeans																										
(1) Proposed cropping pattern / Crop coefficient(Kc)																		**Mungbeans**								
- Pwj(3)-1																		0.45	0.75	1.05	0.30					
- Pwj(3)-2																			0.45	0.75	1.05	0.30				
- Pwj(3)-3																				0.45	0.75	1.05	0.30			
(2) Crop consumptive use(Etc)																										
- Pwj(3)-1	mm																	37		64	95	23				
- Pwj(3)-2	mm																			38	68	81	23			
- Pwj(3)-3	mm																				41	58	81	20		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(3)-1	mm																	37		53	83	0				173
- Pwj(3)-2	mm																			27	56	44	0			128
- Pwj(3)-3	mm																				29	21	43	0		93
(5) Diversion requirement	mm																	25		53	112	44	29	0		263
	m3/ha																	250		530	1,120	440	290	0		2,630

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 2.3 Irrigation Water Requirement in Ncoha II Project (4/4)

Site : Ncoha-II
Crops : Palawija (2/2) : Tomato and Cabbage

Item		Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2	May 1	May 2	Jun. 1	Jun. 2	Jul 1	Jul 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Annual
	(days)	15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)	mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
	mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Palawija(4) : Tomato																										
(1) Proposed cropping pattern / Crop coefficient(Kc)																Tomato										
- Pwj(4)-1																0.45	0.75	1.05	1.05	0.80	0.60					
- Pwj(4)-2																	0.45	0.75	1.05	1.05	0.80	0.60				
- Pwj(4)-3																		0.45	0.75	1.05	1.05	0.80	0.60			
(2) Crop consumptive use(Etc)																										
- Pwj(4)-1	mm															35		61	86	89	73	47				
- Pwj(4)-2	mm																	37	61	89	95	62	47			
- Pwj(4)-3	mm																		37	64	95	81	62	40		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(4)-1	mm															35		61	86	78	61	10				331
- Pwj(4)-2	mm																	37	61	78	83	25	9			294
- Pwj(4)-3	mm																		37	53	83	44	24	0		242
(5) Diversion requirement	mm															23		65	123	140	152	53	22	0		577
	m3/ha															230		650	1,230	1,400	1,520	530	220	0		5,780
III. Palawija (5) : Cabbage																										
(1) Proposed cropping pattern / Crop coefficient(Kc)																Cabbage										
- Pwj(5)-1																0.45	0.70	0.95	0.90	0.80						
- Pwj(5)-2																	0.45	0.70	0.95	0.90	0.80					
- Pwj(5)-3																		0.45	0.70	0.95	0.90	0.80				
(2) Crop consumptive use(Etc)																										
- Pwj(5)-1	mm																	37	57	81	82	62				
- Pwj(5)-2	mm																		37	60	86	70	62			
- Pwj(5)-3	mm																			38	64	74	70	53		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(5)-1	mm																	37	57	70	70	25				259
- Pwj(5)-2	mm																		37	49	74	33	24			217
- Pwj(5)-3	mm																			27	52	37	32	0		147
(5) Diversion requirement	mm																	25	63	97	130	63	37	0		415
	m3/ha																	250	630	970	1,300	630	370	0		4,150

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 3.1 Estimated Catchment Rainfall in Ncoha II Embung Site

Unit : mm

year	Jan		Feb		Mar.		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1970	88	133	152	172	73	11	7	81	14	13	17	0	0	0	0	0	6	2	6	0	174	110	69	66	1,194
1971	95	235	102	102	61	235	13	25	15	15	6	8	8	0	0	0	0	0	0	35	101	119	151	145	1,471
1972	55	14	40	26	138	36	29	4	0	0	0	0	0	0	0	0	0	0	0	0	0	17	257	53	669
1973	109	90	132	98	99	79	44	24	55	70	0	7	7	0	0	0	2	9	0	7	154	83	53	105	1,227
1974	70	44	88	242	68	11	45	11	11	4	0	0	0	7	0	0	2	0	3	35	59	163	90	113	1,066
1975	76	54	70	19	45	147	157	47	46	17	0	0	0	0	0	0	20	3	19	152	29	86	149	61	1,197
1976	138	6	129	34	164	41	12	0	0	0	0	0	0	0	0	0	0	0	0	86	6	86	193	128	1,023
1977	149	240	102	197	103	92	61	0	13	0	0	0	0	0	0	0	0	0	0	0	0	29	134	123	1,243
1978	209	69	97	186	54	189	54	7	2	20	26	19	30	3	8	11	14	11	22	36	52	18	44	91	1,272
1979	108	143	23	119	111	2	0	0	58	34	18	0	0	0	0	0	0	0	0	0	0	0	0	0	616
1980	43	77	29	47	6	26	17	0	0	12	0	0	0	0	0	0	0	0	0	0	3	94	152	111	617
1981	118	56	246	75	98	53	14	0	44	12	51	0	0	0	0	0	28	25	9	0	98	105	87	35	1,154
1982	154	77	87	145	124	36	46	0	0	0	0	0	0	0	6	0	0	0	0	0	0	6	12	29	722
1983	229	0	47	40	73	39	73	14	11	2	1	0	0	0	0	0	0	0	19	88	30	261	9	45	981
1984	76	100	326	119	80	127	65	58	50	9	0	14	0	0	4	0	30	53	13	2	35	57	110	0	1,328
1985	0	272	63	197	273	10	1	45	0	14	21	0	0	0	0	0	0	0	0	10	1	117	149	15	1,188
1986	310	59	142	155	72	56	103	58	0	0	14	34	0	0	0	0	15	0	0	84	30	55	128	14	1,329
1987	152	165	120	128	3	37	4	48	0	0	10	4	3	0	0	3	0	0	0	0	13	114	479	169	1,452
1988	51	223	92	17	45	213	39	3	29	3	8	0	0	0	0	0	4	0	64	14	36	173	74	108	1,196
1989	69	84	66	136	31	92	13	17	14	25	29	61	2	26	0	0	0	0	0	46	34	43	196	19	1,003
1990	213	244	164	130	153	26	0	8	22	0	3	0	7	0	0	0	0	0	2	22	0	8	141	231	1,374
Mean	120	114	110	114	89	74	38	21	18	12	10	7	3	2	1	1	6	5	7	29	41	83	127	79	1,111

Table 3.2 Estimated Discharge at Ncoha II Embung Site

Unit : 1000 m3

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
year	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1970	388	587	670	759	322	0	0	357	0	0	0	0	0	0	0	0	0	0	0	0	767	485	304	291	4.930
1971	419	1,036	450	450	269	1,036	0	110	0	0	0	0	0	0	0	0	0	0	0	154	445	525	666	639	6.199
1972	243	0	176	115	609	159	128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,133	234	2.797
1973	481	397	582	432	437	348	194	106	243	309	0	0	0	0	0	0	0	0	0	0	679	366	234	463	5.271
1974	309	194	388	1,067	300	0	198	0	0	0	0	0	0	0	0	0	0	0	0	154	260	719	397	498	4,484
1975	335	238	309	0	198	648	692	207	203	0	0	0	0	0	0	0	0	0	0	670	128	379	657	269	4,933
1976	609	0	569	150	723	181	0	0	0	0	0	0	0	0	0	0	0	0	0	379	0	379	851	564	4,405
1977	657	1,058	450	869	454	406	269	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	591	542	5,424
1978	922	304	428	820	238	833	238	0	0	0	115	0	132	0	0	0	0	0	97	159	229	0	194	401	5.110
1979	476	631	101	525	490	0	0	0	256	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,629
1980	190	340	128	207	0	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	415	670	490	2,555
1981	520	247	1,085	331	432	234	0	0	194	0	225	0	0	0	0	0	123	110	0	0	432	463	384	154	4,934
1982	679	340	384	639	547	159	203	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	3,079
1983	1,010	0	207	176	322	172	322	0	0	0	0	0	0	0	0	0	0	0	0	388	132	1,151	0	198	4,078
1984	335	441	1,438	525	353	560	287	256	221	0	0	0	0	0	0	0	132	234	0	0	154	251	485	0	5,672
1985	0	1,200	278	869	1,204	0	0	198	0	0	93	0	0	0	0	0	0	0	0	0	0	516	657	0	5,015
1986	1,367	260	626	684	318	247	454	256	0	0	0	150	0	0	0	0	0	0	0	370	132	243	564	0	5,671
1987	670	728	529	564	0	163	0	212	0	0	0	0	0	0	0	0	0	0	0	0	0	503	2,112	745	6,226
1988	225	983	406	0	198	939	172	0	128	0	0	0	0	0	0	0	0	0	282	0	159	763	326	476	5,057
1989	304	370	291	600	137	406	0	0	0	110	128	269	0	115	0	0	0	0	0	203	150	190	864	0	4,137
1990	939	1,076	723	573	675	115	0	0	97	0	0	0	0	0	0	0	0	0	0	97	0	0	622	1,019	5,936
Mean	528	497	487	493	392	320	150	81	64	27	27	20	6	5	0	0	12	16	18	123	175	356	558	339	4,692
	1,024		980		712		231		91		47		12		0		29		141		531		896		

Table 3.3 Probable Flood Discharge at Ncoha II Embung Site

Characteristics of the catchment area								
Catchment Area	(km2)	12.60						
Eelevation at Dam Site (1)	(m)	100						
Maximum elevation in the catchment area (2)	(m)	1000						
Height (3)=(2)-(1)	(h)	900						
Length of Catchment Area (L	(m)	10,000						
Flow velocity	W2 (km/hr)	16.98						
Time of concentration	T2 (hrs)	0.59						
Probable Flood Discherge								
Return Period	(years)	2	5	10	20	50	100	200
Rainfall	(mm/day)	79	98	109	120	133	143	152
Rainfall intensity within the time of concentration	(mm)	21	26	29	32	35	38	40
Probable Flood Discharge	(m3/s)	59	73	81	89	99	107	113
Specific Discharge	(m3/s/km2)	5	6	6	7	8	8	9

To estimate design rainfall, the Log Pearson III method is adopted.
The rational method is adopted for estimation of the design flood discharge.
C = 0.8 is used to estimate designed flood discharge by the rational method.

Table 3.4 Result of Water Quality Test in Ncoha II Embung Site

DESCRIPTION	UNIT	1 Upstream of proposed embung	2 Embung Site	3 Embung Site	4 downstream of proposed embung	Max. Limit of B Class by GR. NO. 20/1990
I. PHYSICS						
1 Temperature	C				30.00	Normal water temperature
2 Dissolved solid matter	mg/liter				346.00	1000
3 Electric Conductivety	umhos/cm				472.00	-
II. CHEMISTRY						
a. Unorganic chemistry						
1 Mercury	mg/liter				0.00	0.001
2 Ammonia	mg/liter				0.00	0.5
3 Arsenic	mg/liter				-	0.05
4 Barium	mg/liter				-	5
5 Ferro	mg/liter				0.00	1
6 Fluoride	mg/liter				0.44	1.5
7 Cadmium	mg/liter				0.00	0.005
8 Chloride	mg/liter				41.80	600
9 Chronium, valense-6	mg/liter				0.00	0.05
10 Manganese	mg/liter				0.00	0.5
11 Nitrate, N	mg/liter				0.18	10
12 Nitric, N	mg/liter				0.11	1
13 Dissolved Oxygen	mg/liter				1.72	*
14 pH	-				6.80	5-9
15 Selenium	mg/liter				-	0.01
16 Zinc	mg/liter				0.00	5
17 Cyanide	mg/liter				0.00	0.1
18 Sulphate	mg/liter				16.30	400
19 Sulfide, H2S	mg/liter				0.00	0.1
20 Copper	mg/liter				0.00	1
21 Lead	mg/liter				0.00	0.1
b. Organic Chemistry						
1 Aldrin and Dieldrin	mg/liter				0.00	0.017
2 Chlordane	mg/liter				0.00	0.003
3 DDT	mg/liter				0.00	0.042
4 Endrine	mg/liter				0.00	0.001
5 Fenol	mg/liter				0.00	0.001
6 Heptachlor and Heptachlor Epoxide	mg/liter				-	0.018
7 Carbon Cloroform Ektract	mg/liter				-	0.5
8 Lindane	mg/liter				0.00	0.056
9 Methoxychlor	mg/liter				-	0.035
10 Oil and Fat	mg/liter				0.00	Nil
11 Organofosphate and Carbomate	mg/liter				0.00	0.1
12 PCB	mg/liter				-	Nil
13 Senyawa alife biru (Sulfaktan)	mg/liter				0.50	0.5
14 Toxaphene	mg/liter				0.00	0.005
III MICRO BIOLOGY						
1 Coliform tinja	per 100 ml				13,000	2,000
2 Total Coliform	per 100 ml				22,000	10,000

NOTE:
* = The water level shall be more than or equal to 6.
mg = miligram
ml = Milimeter
Bq = Bequerel

Heavy metals are classified into dissolved matter.

Source : JICA's Water Quality Test

Table 7.1 Summary of Construction Cost in Ncoha II Project

	Item	Amount (Rp. million)
I.	Direct Construction Cost	
1.1	Preparatory Works	406
1.2	Embung Construction	
	1) Main dam	4,251
	2) Spillway	2,846
	3) Diversion Tunnel	0
	4) Seepage protection works	0
	5) Miscellaneous	710
	Sub-total of 1.2	7,807
1.3	Irrigation Facilities	313
1.4	Domestic Water Supply	0
1.5	Embung Operation and Maintenance Road	0
	Sub-total of I.	8,526
II.	Administration Cost	426
III.	Engineering Services	1,279
	Sub-total of I, II & III	10,231
IV.	Physical Contingency	1,535
	Sub-total of I, II, II, & IV	11,766
V.	Contract Tax	1,134
VI.	Land Acquisition Cost	43
	Sub-total I, II, III, IV, V & VI	12,942
VII.	Price Contingency	2,588
	GRAND TOTAL	15,531

Table 7.2 Direct Construction Cost in Ncoha II Project (1/2)

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
I. Dam				
1. Main Dam				
1.1 Earth/stone works				
1) Clearing	m2	400	3,300	1,320
2) Excavation, common	m3	3,500	4,900	17,150
, weathered rock	m3	7,500	92,100	690,750
, rock	m3	11,500	2,000	23,000
3) Embankment, impervious soil	m3	8,000	81,700	653,600
, filter	m3	12,000	41,700	500,400
, transition	m3	12,000	0	0
, random material	m3	6,000	331,200	1,987,200
4) Stone masonry	m3	80,000	0	0
5) Rip-rap protection	m3	15,000	11,700	175,500
1.2 Grouting	m	71,000	0	0
1.3 Other miscellaneous works				202,446
Sub-total of 1.				4,251,366
2. Spillway				
2.1 Earth works				
1) Clearing	m2	400	12,200	4,880
2) Excavation, common soil	m3	3,500	25,500	89,250
, weathered rock	m3	7,500	63,700	477,750
, rock	m3	11,500	38,200	439,300
3) Backfill	m3	5,200	5,800	30,160
2.2 Concrete works				
1) Concrete - A	m3	250,000	330	82,500
2) Concrete - B	m3	170,000	6,270	1,065,900
3) Reinforcement bar	ton	1,500,000	17	25,500
4) Form	m2	15,000	33,000	495,000
2.3 Other miscellaneous works	L.S			135,512
Sub-total of 2.				2,845,752
3. Miscellaneous & Others				709,712
Total - I.				7,806,830
II. Irrigation Facilities				
1. Canal works (including the rehabilitation works)				
1.1 Earth works				
1) Clearing	m2	400	21,300	8,520
2) Excavation	m3	5,000	2,200	11,000
3) Embankment	m3	6,300	3,300	20,790
1.2 Stone masonry	m3	80,000	2,500	200,000
Sub-total of 1.				240,310

Table 7.2 Direct Construction Cost in Ncoha II Project (2/2)

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
2. Related structures				
2.1 Turnout	nos.	2,540,000	3	7,620
2.2 Syphon	nos.	5,500,000	1	5,500
2.3 Aqueduct		5,975,000		0
2.3 Cross drain	nos.	4,700,000	1	4,700
2.4 Irrigation division box	nos.	900,000	29	26,100
2.5 Division box for livestock		1,170,000		
Sub-total of 2.				43,920
3. Miscellaneous & Others	L.S			28,423
Total - II				312,653
GRAND TOTAL				8,119,483

Table 8.1 Economic Construction Costs and Annual Disburement Schedule

Ncoha II Project (Unit : Rp. million)

Item	SCF	Total cost	1st year	2nd year	3rd year
1 Direct Construction Cost		5,549	144	2,370	3,035
1) Preparatory Works	0.71	288	144	144	0
2) Dam Construction					
- Main dam	0.71	3,018	0	1,509	1,509
- Spillway	0.71	2,021	0	606	1,415
- Diversion tunnel	0.71	0	0	0	0
- Seepage protection works	0.71	0	0	0	0
Sub-total		5,039	0	2,115	2,924
3) Irrigation Facilities	0.71	222	0	111	111
4) Domestic Water Supply System	0.71	0	0	0	0
5) Dam O & M Road	0.71	0	0	0	0
2 Administration Cost	0.90	383	10	164	209
3 Engineering Services	0.90	528	210	159	159
4 Physical Contingency		833	22	356	455
Total		7,293	386	3,049	3,858

Note : Standard Conversion Factors (SFC). Source ; Pedoman Pengamatan dan Evaluasi Proyek-Proyek Pengairan, Direktorato Jeneral Pengairan, 1985

Table 8.2 Financial and Economic Prices of Farm Inputs and Outputs in NTB

	Item		Unit	Lombok		Sumbawa	
				Financial Price *1	Economic Price *2	Financial Price *1	Economic Price *2
1	Farm Products						
	Paddy *3		kg	280	397	260	394
	Maize *3		kg	200	220	200	215
	Mungbeans *3		kg	1,000	906	1,000	901
	Soybeans *3		kg	900	647	900	642
	Red onion *4		kg	900	704	800	699
	Tobacco *5		kg	900	522	900	521
2	Seeds						
	Paddy	Certified	kg	605	605	605	605
		Own	kg	-	325	-	325
	Maize	Certified	kg	922	922	922	922
		Own	kg	-	297	-	297
	Mungbeans	Certified	kg	1,383	1,383	1,383	1,383
		Own	kg	-	893	-	893
	Soybeans	Certified	kg	617	617	617	617
		Own	kg	-	606	-	606
	Red onion		kg	850	850	850	850
	Tobacco		kg	25,000	25,000	25,000	25,000
3	Fertilisers						
	Urea		kg	350	414	350	419
	TSP		kg	400	486	400	491
	KCl		kg	400	416	400	421
4	Agro-chemicals						
	Insecticides	Liquid type	lit	10,000	10,000	10,000	10,000
		Powder type	kg	3,000	3,000	3,000	3,000
	Rodenticides		kg	5,500	5,500	5,500	5,500
5	Labour						
	Hired labour *6		man-day	3,000	2,250	2,500	1,875
	Family labour		man-day	-	2,250	-	1,875
6	Draft Animal						
	Hired		head-day	6,000	6,000	5,000	5,000
	Own		head-day	-	6,000	-	5,000
7	Farm Machinery						
	Tractor		ha	250,000	250,000	200,000	200,000

Remarks : *1 ; As of 1994

*2 ; Projected prices in 2005 at 1994 constant prices

*3 ; Dry grain

*4 ; Fresh

*5 ; Fresh leaves

*6 ; Economic conversionfactor is 0.75.

Table 8.3 Economic Crop Budget per Ha

Ncoha II Project

Item		Q'ty of Unit	Value (Rp.)	Without Project: Paddy (Irrigated) Q'ty	Without Project: Paddy (Irrigated) Am't (Rp.)	Without Project: Paddy (Rainfed) Q'ty	Without Project: Paddy (Rainfed) Am't (Rp.)	Without Project: Mungbean (2nd crop) (Rainfed) Q'ty	Without Project: Mungbean (2nd crop) (Rainfed) Am't (Rp.)	With Project: Paddy (Irrigated) Q'ty	With Project: Paddy (Irrigated) Am't (Rp.)	With Project: Mungbean (Irrigated) Q'ty	With Project: Mungbean (Irrigated) Am't (Rp.)	With Project: Red Onion (Irrigated) Q'ty	With Project: Red Onion (Irrigated) Am't (Rp.)
1 Gross Production Value															
Paddy		kg	394	3,000	1,182,000	2,000	788,000	0	0	4,500	1,773,000	0	0	0	0
Soybean		kg	642	0	0	0	0	0	0	0	0	0	0	0	0
Mungbean		kg	901	0	0	0	0	500	450,500	0	0	1,200	1,081,200	0	0
Red onion		kg	699	0	0	0	0	0	0	0	0	0	0	7,500	5,242,500
2 Production Cost															
Seed															
Paddy	Certified	kg	605	50	30,250	0	0	0	0	25	15,125	0	0	0	0
	Own	kg	325	0	0	50	16,250	0	0	0	0	0	0	0	0
Soybean	Certified	kg	617	0	0	0	0	0	0	0	0	0	0	0	0
	Own	kg	606	0	0	0	0	0	0	0	0	0	0	0	0
Mungbean	Certified	kg	1,383	0	0	0	0	7	9,681	0	0	10	13,830	0	0
	Own	kg	893	0	0	0	0	28	25,004	0	0	20	17,860	0	0
Red onion	Certified	kg	850	0	0	0	0	0	0	0	0	0	0	2,000	1,700,000
Fertiliser															
Urea		kg	419	225	94,275	150	62,850	20	8,380	300	125,700	75	31,425	300	125,700
TSP		kg	491	75	36,825	50	24,550	40	19,640	100	49,100	100	49,100	200	98,200
KCl		kg	421	35	14,735	0	0	20	8,420	50	21,050	50	21,050	100	42,100
Agro-chemicals															
Insecticide	Lquid	lit	10,000	2.0	20,000	0.5	5,000	0.0	0	2.0	20,000	2.0	20,000	10.0	100,000
	Powder	kg	3,000	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Rodenticide		kg	5,500	2.0	11,000	0.5	2,750	0.0	0	2.0	11,000	1.0	5,500	3.0	16,500
Labor															
Family		md	1,875	127	238,125	65	121,875	20	37,500	172	322,500	80	150,000	151	283,125
Hired		md	1,875	13	24,375	10	18,750	0	0	13	24,375	0	0	99	185,625
Draft Animal															
Family		ad	5,000	20	100,000	10	50,000	0	0	20	100,000	10	50,000	20	100,000
Hired		ad	5,000	0	0	0	0	0	0	0	0	0	0	0	0
Tractor		ha	200,000	0	0	0	0	0	0	0	0	0	0	0	0
Total production cost					569,585		302,025		108,625		688,850		358,765		2,651,250
3 Net Production Value					612,415		485,975		341,875		1,084,150		722,435		2,591,250

Table 8.4 Economic Costs and Benefits Flow

Ncoha II Project Unit : Million Rp.

Year	Cost				Benefit			Increment
	Capital	Replace	O&M	Total	Irrigation	Negative	Total	
1.	386	0	0	386	0	-1	-1	-387
2.	3,049	0	0	3,049	0	-1	-1	-3,050
3.	3,858	0	0	3,858	0	-1	-1	-3,859
4.	0	0	30	30	361	-1	360	330
5.	0	0	30	30	421	0	421	391
6.	0	0	30	30	482	0	482	452
7.	0	0	30	30	542	0	542	512
8.	0	0	30	30	602	0	602	572
9.	0	0	30	30	602	0	602	572
10.	0	0	30	30	602	0	602	572
11.	0	0	30	30	602	0	602	572
12.	0	0	30	30	602	0	602	572
13.	0	0	30	30	602	0	602	572
14.	0	0	30	30	602	0	602	572
15.	0	0	30	30	602	0	602	572
16.	0	0	30	30	602	0	602	572
17.	0	0	30	30	602	0	602	572
18.	0	0	30	30	602	0	602	572
19.	0	0	30	30	602	0	602	572
20.	0	0	30	30	602	0	602	572
21.	0	0	30	30	602	0	602	572
22.	0	0	30	30	602	0	602	572
23.	0	0	30	30	602	0	602	572
24.	0	0	30	30	602	0	602	572
25.	0	0	30	30	602	0	602	572
26.	0	0	30	30	602	0	602	572
27.	0	0	30	30	602	0	602	572
28.	0	0	30	30	602	0	602	572

EIRR = 5.0 %

Table 8.5 Financial Crop Budget per Ha

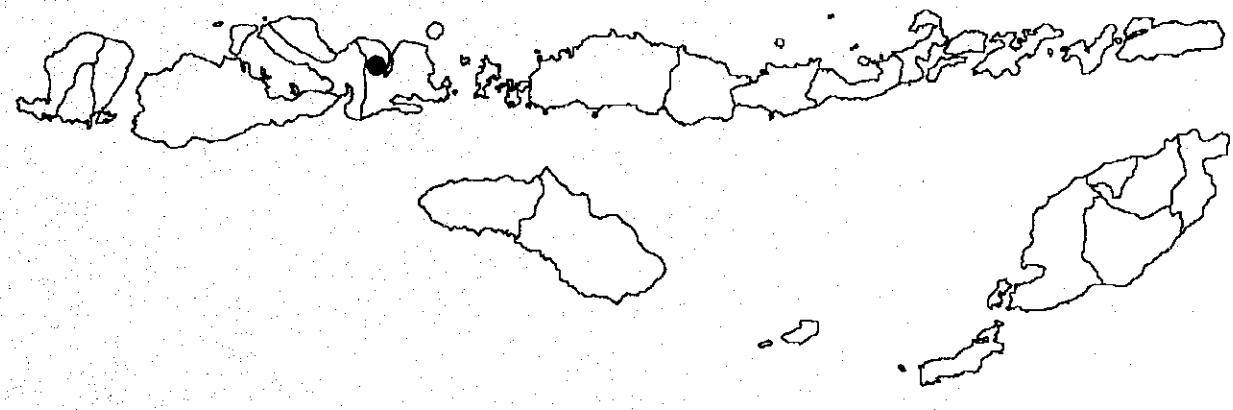
Ncoha II Project

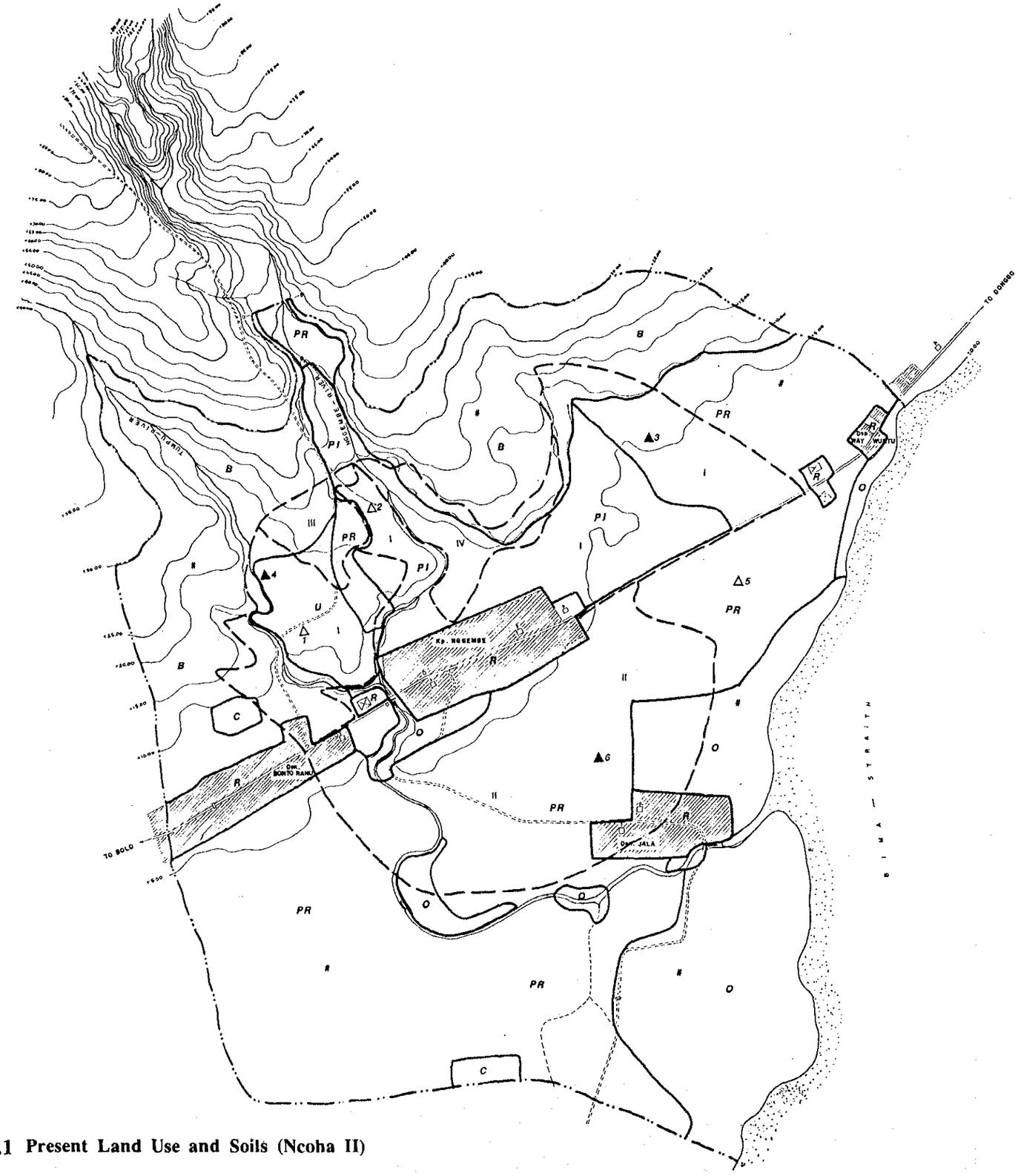
Item		Q'ty of Unit	Value (Rp.)	Without Project: Paddy (Irrigated) Q'ty	Without Project: Paddy (Irrigated) Am't (Rp.)	Without Project: Paddy (Rainfed) Q'ty	Without Project: Paddy (Rainfed) Am't (Rp.)	Without Project: Mungbean (2nd crop) (Rainfed) Q'ty	Without Project: Mungbean (2nd crop) (Rainfed) Am't (Rp.)	With Project: Paddy (Irrigated) Q'ty	With Project: Paddy (Irrigated) Am't (Rp.)	With Project: Mungbean (Irrigated) Q'ty	With Project: Mungbean (Irrigated) Am't (Rp.)	With Project: Red Onion (Irrigated) Q'ty	With Project: Red Onion (Irrigated) Am't (Rp.)
1 Gross Production Value															
Paddy		kg	260	3.000	780.000	2.000	520.000	0	0	4.500	1.170.000	0	0	0	0
Soybean		kg	900	0	0	0	0	0	0	0	0	0	0	0	0
Mungbean		kg	1.000	0	0	0	0	500	500.000	0	0	1.200	1.200.000	0	0
Red onion		kg	800	0	0	0	0	0	0	0	0	0	0	7.500	6.000.000
2 Production Cost															
Seed															
Paddy	Certified	kg	605	50	30.250	0	0	0	0	25	15.125	0	0	0	0
	Own	kg	0	0	0	50	0	0	0	0	0	0	0	0	0
Soybean	Certified	kg	617	0	0	0	0	0	0	0	0	0	0	0	0
	Own	kg	0	0	0	0	0	0	0	0	0	0	0	0	0
Mungbean	Certified	kg	1.383	0	0	0	0	7	9.681	0	0	10	13.830	0	0
	Own	kg	0	0	0	0	0	28	0	0	0	20	0	0	0
Red onion	Certified	kg	850	0	0	0	0	0	0	0	0	0	0	2.000	1.700.000
Fertiliser															
Urea		kg	350	225	78.750	150	52.500	20	7.000	300	105.000	75	26.250	300	105.000
TSP		kg	400	75	30.000	50	20.000	40	16.000	100	40.000	100	40.000	200	80.000
KCl		kg	400	35	14.000	0	0	20	8.000	50	20.000	50	20.000	100	40.000
Agro-chemicals															
Insecticide	Lquid	lit	10.000	2.0	20.000	0.5	5.000	0.0	0	2.0	20.000	2.0	20.000	10.0	100.000
	Powder	kg	3.000	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Rodenticide		kg	5.500	2.0	11.000	0.5	2.750	0.0	0	2.0	11.000	1.0	5.500	3.0	16.500
Labor															
Family		md	0	127	0	65	0	20	0	172	0	80	0	151	0
Hired		md	2.500	13	32.500	10	25.000	0	0	13	32.500	0	0	99	247.500
Draft Animal															
Family		ad	0	20	0	10	0	0	0	20	0	10	0	20	0
Hired		ad	5.000	0	0	0	0	0	0	0	0	0	0	0	0
Tractor		ha	200.000	0	0	0	0	0	0	0	0	0	0	0	0
Total production cost					216.500		105.250		40.681		243.625		125.580		2.289.000
3 Net Production Value					563.500		414.750		459.319		926.375		1.074.420		3.711.000

The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Ncoha II Embung Development Project

Figures





Legend (Present Land Use/Soils)

Present Land Use		Soils
PI	Paddy Field, Irrigated	I
PR	Paddy Field, Rainfed	II
U	Upland	III
T	Tree Crops	IV
B	Bush/Scrub/Grassland	#
R	Residential	
C	Cemetery	
O	Others	

▲ No — Soil Test Pit with Sampling

△ No — Soil Test Pit without Sampling

——— Boundary of Beneficiary Area

0 100 200 400 600 800 m

SCALE 1 : 14,000

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT, MINISTRY OF PUBLIC WORKS

The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

NCOHA II

No. | Area

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.1 Present Land Use and Soils (Ncoha II)

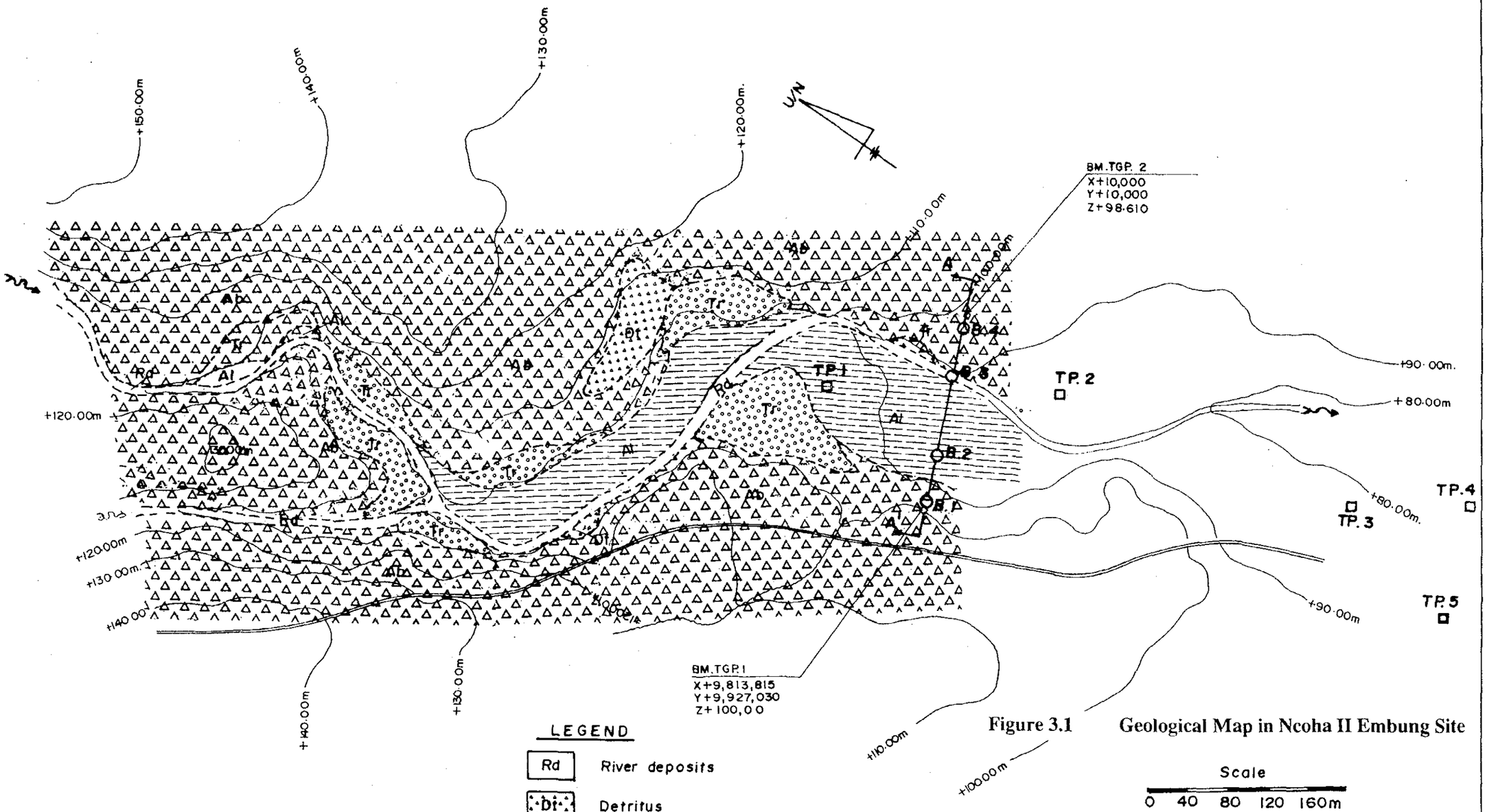


Figure 3.1 Geological Map in Ncoha II Embung Site

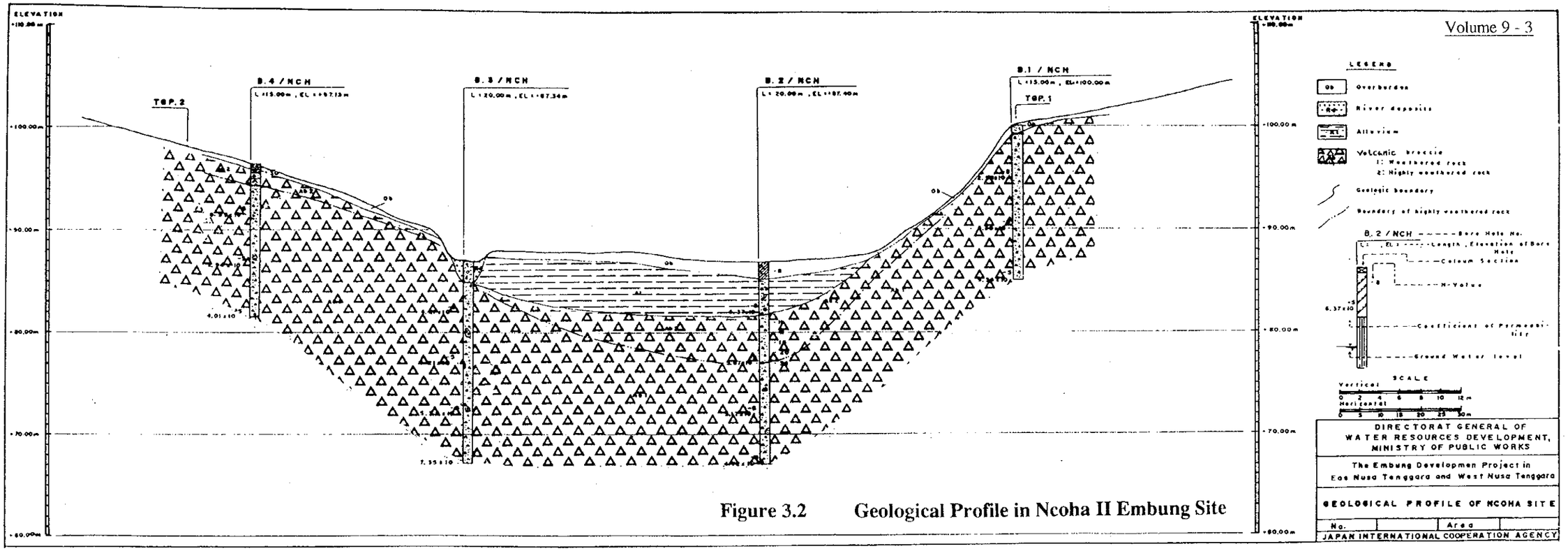


Figure 3.2 Geological Profile in Ncoha II Embung Site

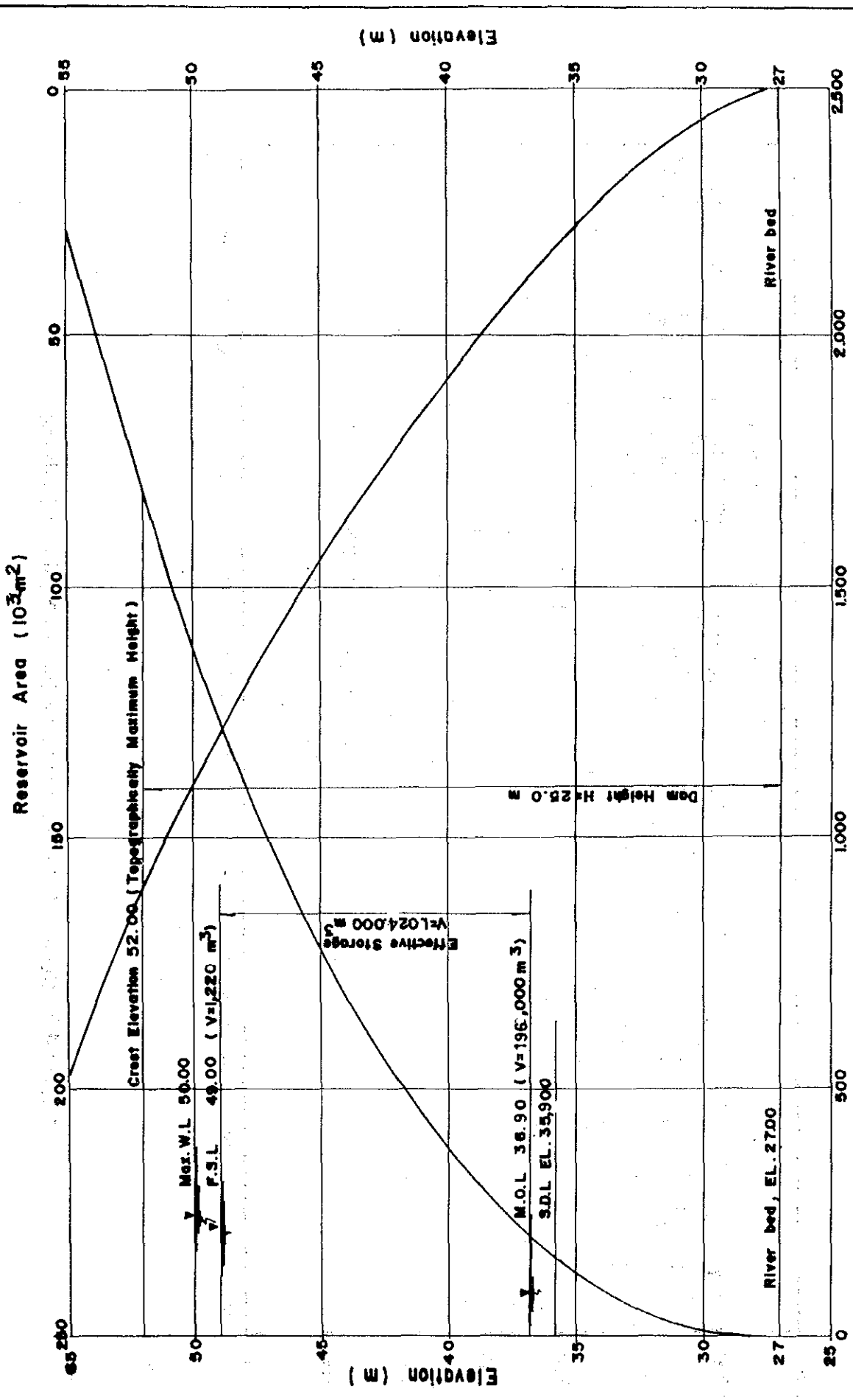


Figure 4.1 Reservoir Storage Curve in Ncoha II Embung

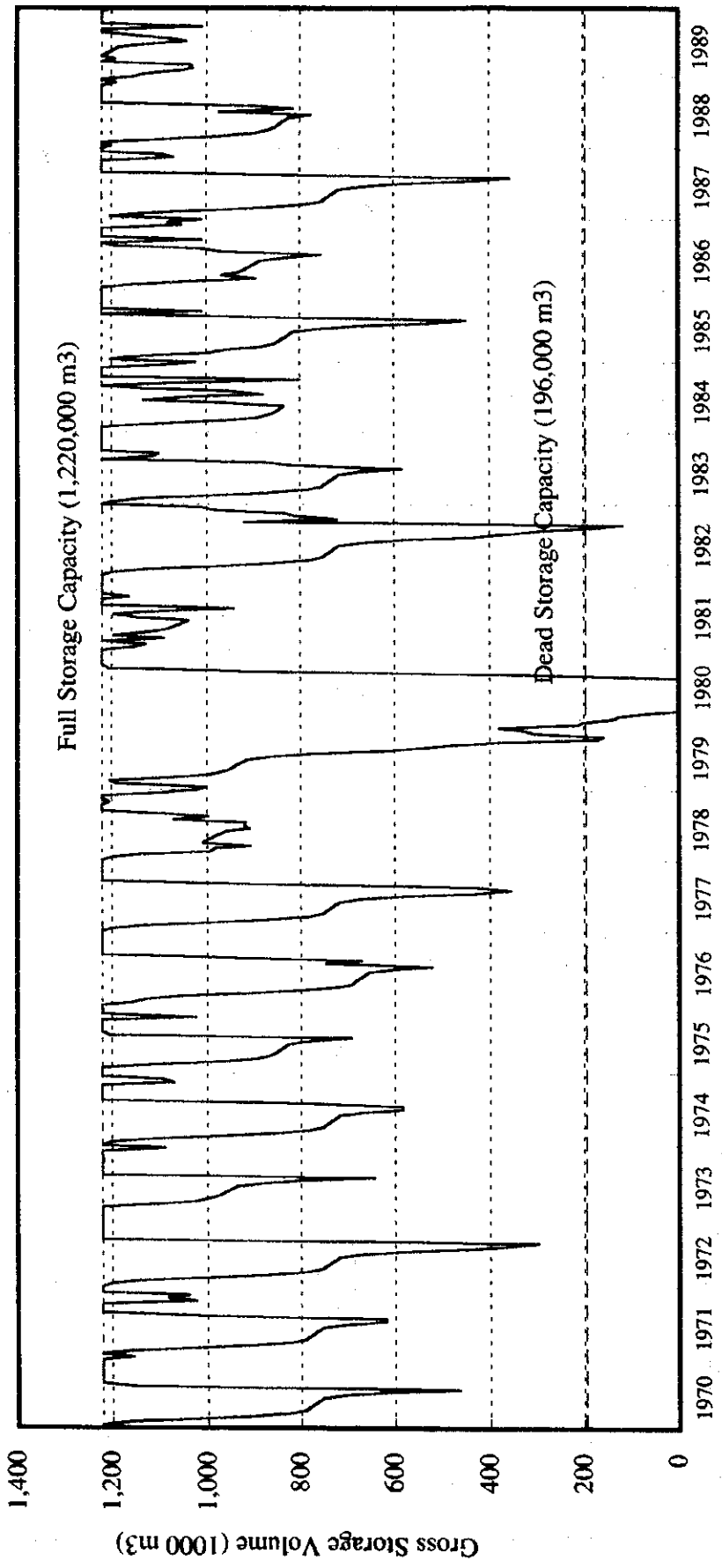


Figure 4.2 Result of Reservoir Operation in Ncoha II Embung

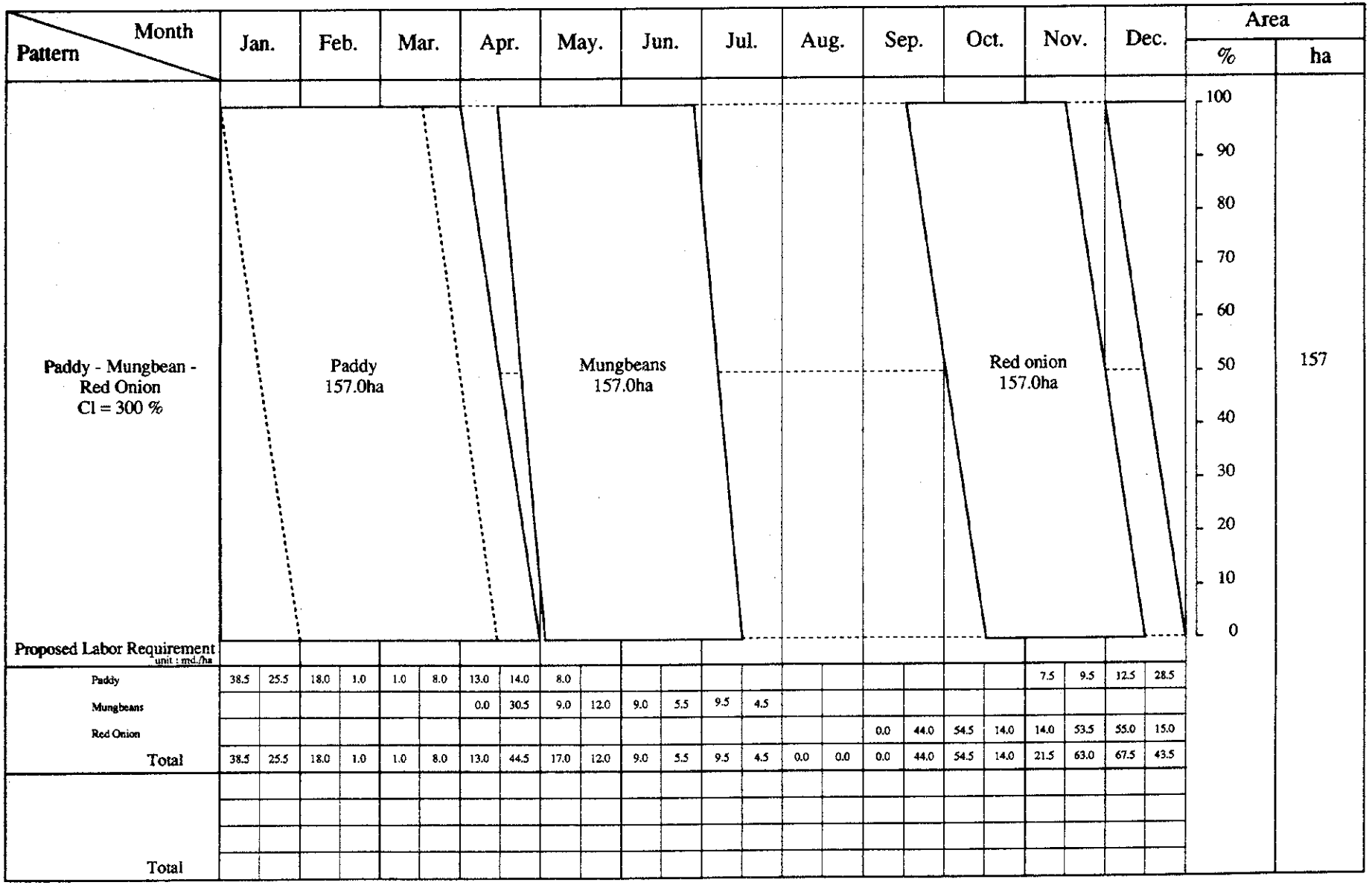
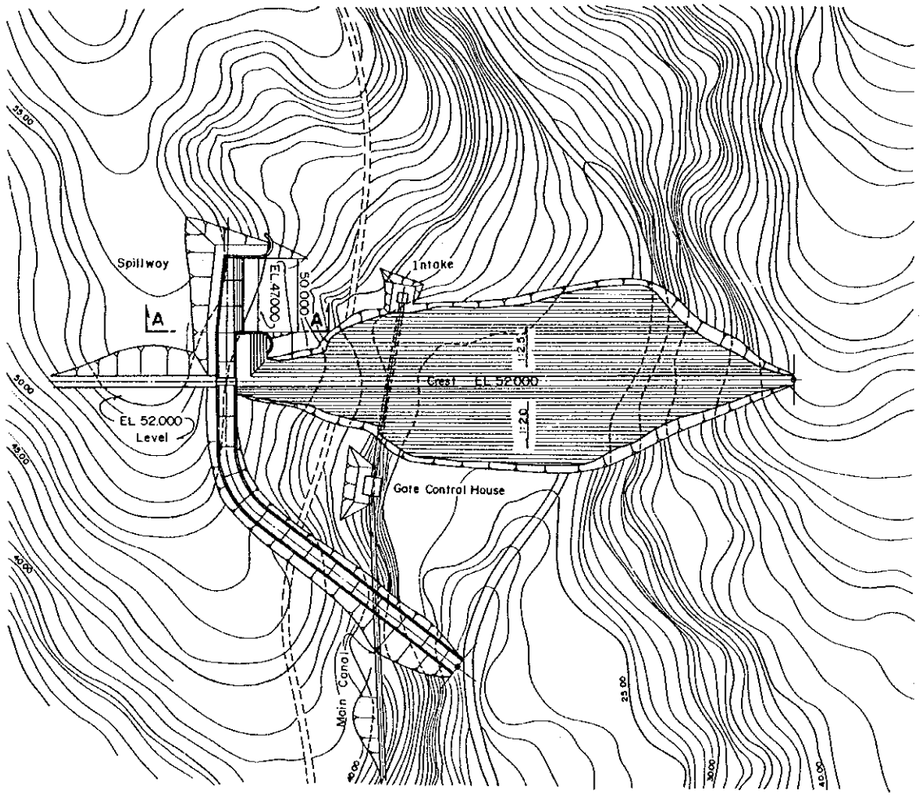
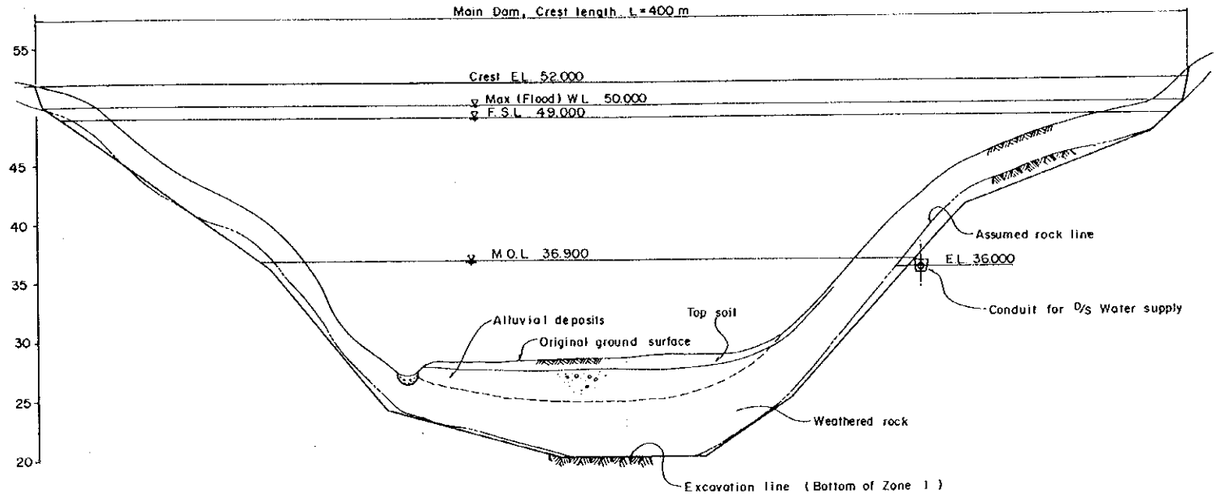


Figure 4.3 Proposed Cropping Pattern for Ncoha II Project

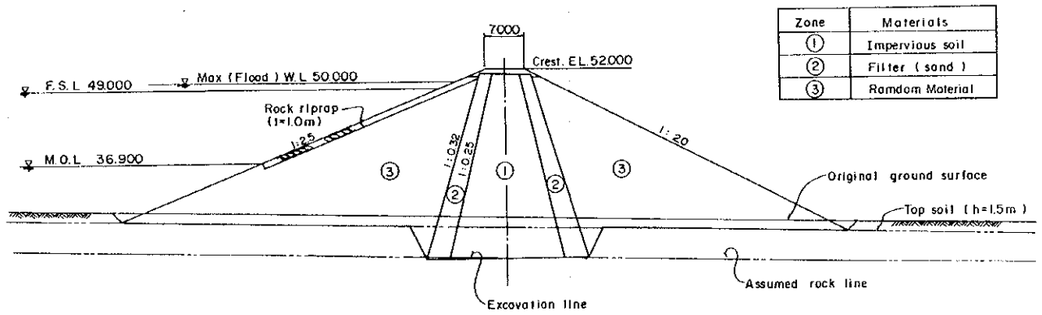


PLAN Scale A



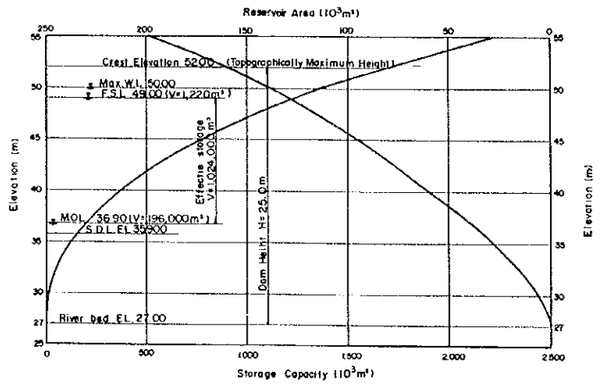
PROFILE OF MAIN DAM

Scale H = 1 : 1000
V = 1 : 250

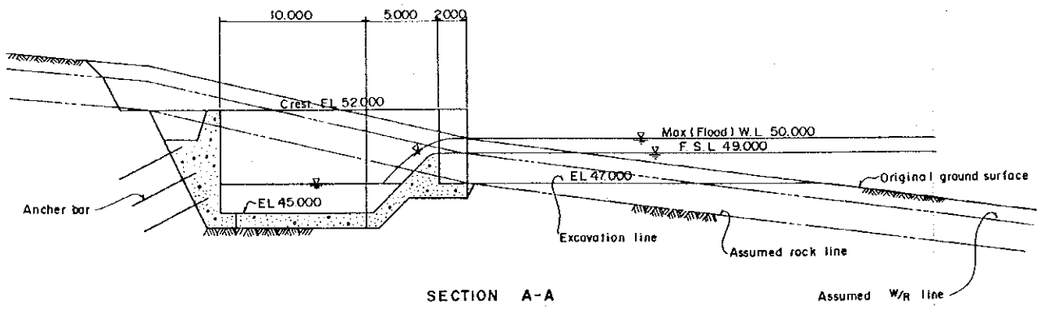


MAXIMUM CROSS SECTION

Scale B



RESERVOIR STORAGE CURVE AT NCOHA-II



SECTION A-A

Scale C

Scale A 0 50 100 150 200m

Scale B 0 10 20 30 40 50m

Scale C 0 5 10 15 20m

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT, MINISTRY OF PUBLIC WORKS

The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

GENERAL PLAN OF NCOHA-II EMBUNG

No. | Area

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 4.4 General Plan of Ncoha II Embung

Legend

- Embung
- Reservoir Area
- Beneficiary Area
- O/ M Road
- Open Channel to be Constructed
- Open Channel to be Rehabilitated
- Pipelines to be Constructed
- Water Distribution Box

0 100 200 400 600 800m
SCALE. 1 : 7,000

DIRECTORATE GENERAL OF
WATER RESOURCES DEVELOPMENT,
MINISTRY OF PUBLIC WORKS

The Embung Development Project in
East Nusa Tenggara and West Nusa Tenggara

NCOHA II

No. | Area

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 5.1 Genelal Layout of Ncoha II Project

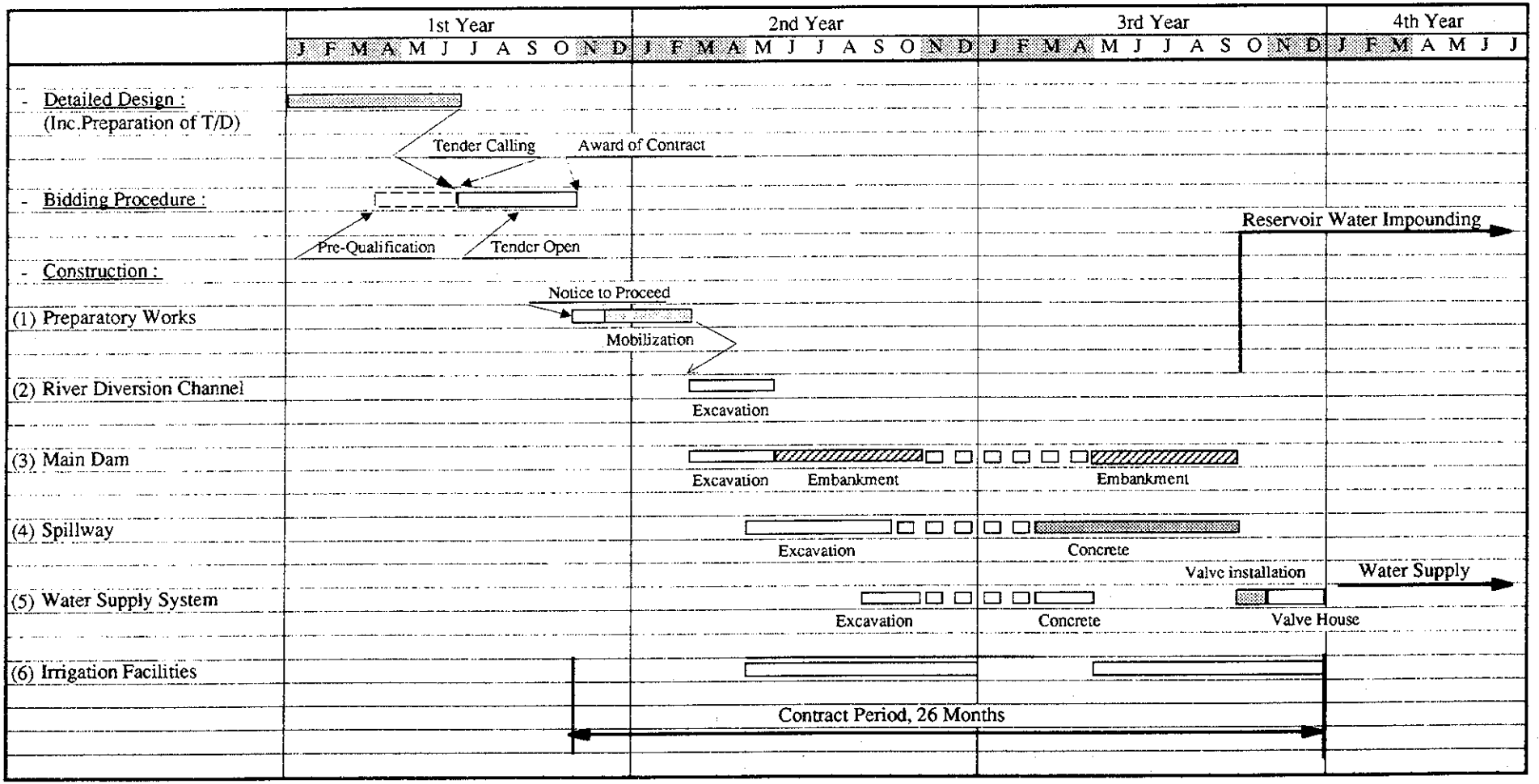


Figure 6.1 Construction Time Schedule for Ncoha II Project

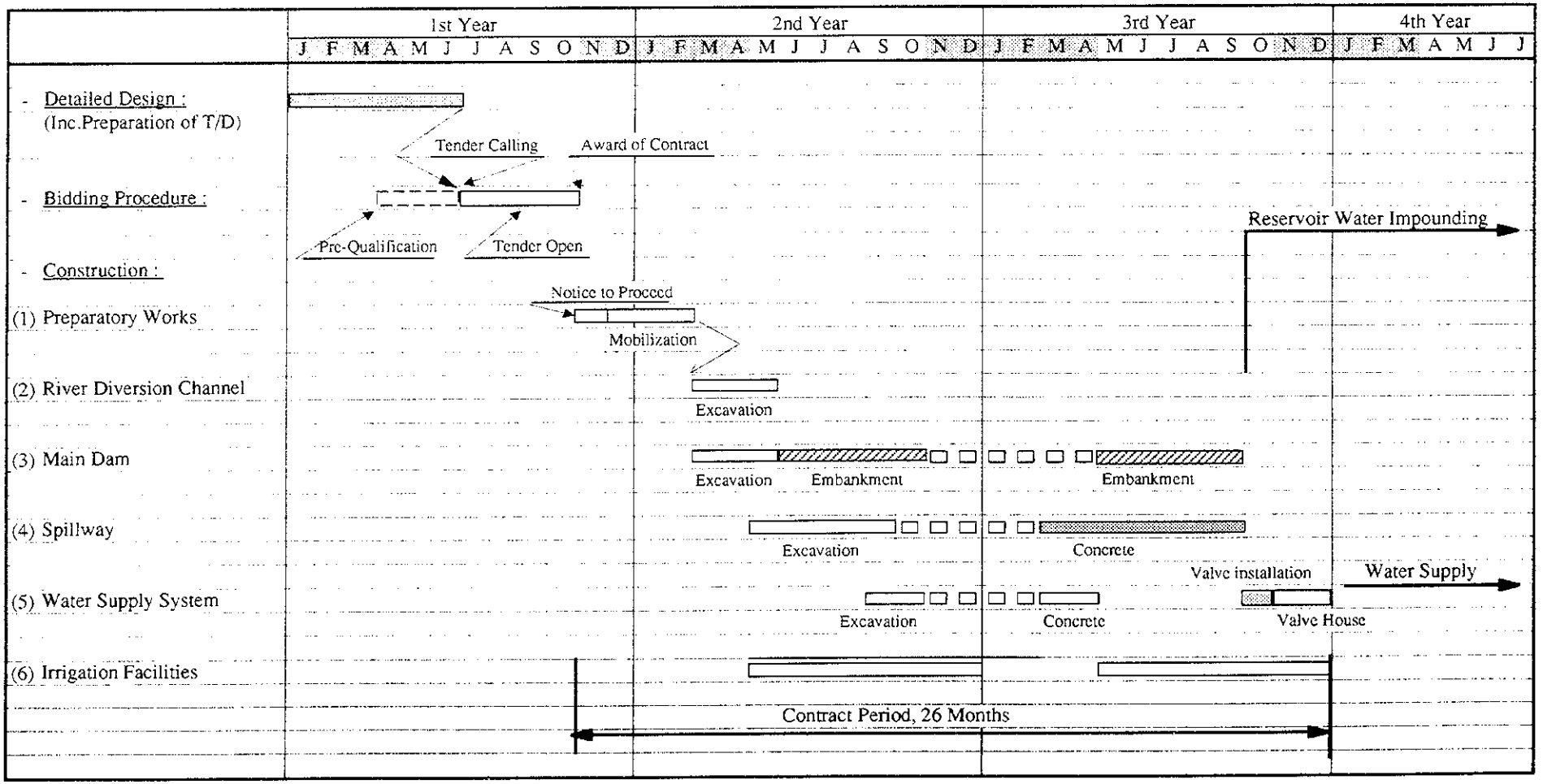


Figure 6.1 Construction Time Schedule for Ncoha II Project

Japan International
Cooperation Agency
(JICA)

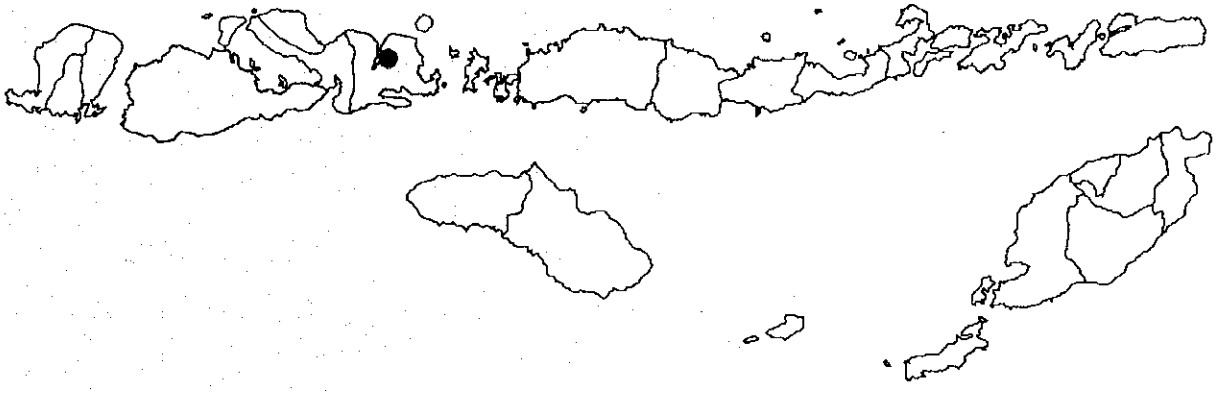
Directorate General of
Water Resources Development,
Ministry of Public Works

The Study
on
The Embung Development Project
(Small Scale Imponding Pond Development Project)
in
East Nusa Tenggara and West Nusa Tenggara
in
The Republic of Indonesia

Final Report

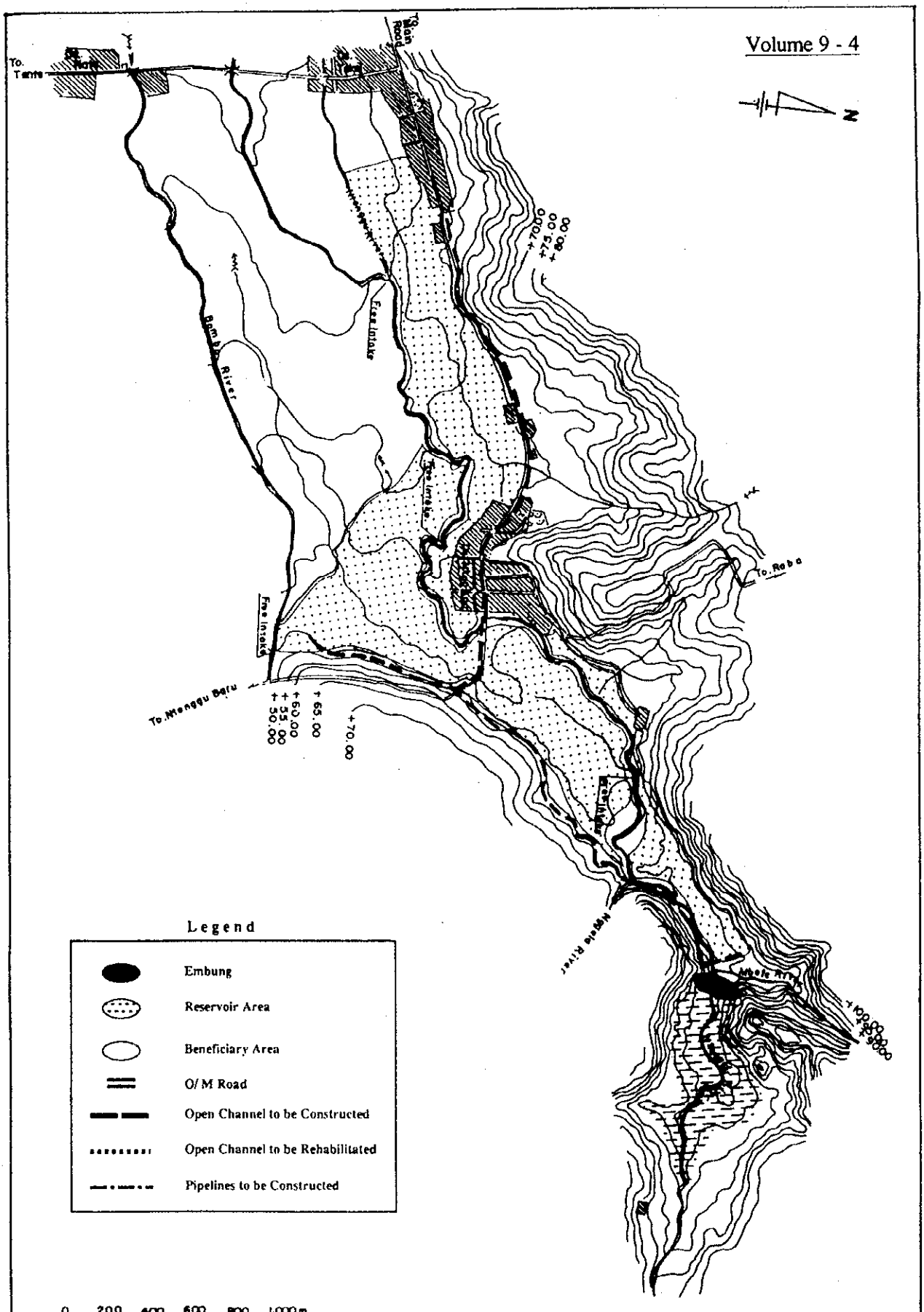
Volume 9-4

Feasibility Study
on
Ntonggu II Embung Development Project



May 1995

Nippon Koei Co., Ltd.



Location Map : NTONGGU II

THE STUDY
ON
THE EMBUNG DEVELOPMENT PROJECT
(SMALL SCALE IMPOUNDING POND DEVELOPMENT PROJECT)
IN
EAST NUSA TENGGARA AND WEST NUSA TENGGARA
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

VOLUME 9-4

FEASIBILITY STUDY
ON
NTONGGU II EMBUNG DEVELOPMENT PROJECT

Table of Contents

List of Tables

List of Figures

1. PRESENT SITUATION OF THE PROJECT AREA

1.1 Location and Topography

The Project area is located in Ntonggu Village in Kecamatan Belo of Kabupaten Bima. The proposed Embung site is located upstream of the Ntonggu river about 35 km south from Bima on Sumbawa Island of Nusa Tenggara Barat (NTB).

Topographical condition of the catchment area is fairly steep slope up to the mountain zone, while the reservoir area is rather flat.

Beneficiary area is situated along the Ntonggu river between the mountainous zone and coastal area of Bima bay.

1.2 Climate and Hydrology

The nearest climate station from the proposed Embung site is Godo station while there are three rainfall stations near the proposed Embung site; Sila, Raba, and Teke. The wet season usually starts from late November and ends late March in the Project area with the average annual rainfall of 1,030 mm. Mean annual temperature is 27.8 °C with the average maximum temperature of 33.0 °C and the average minimum temperature of 22.4 °C. Mean relative humidity is 84.8 %. Average sunshine hours are 3 to 5 hr/day during the wet season and increase to 6 to 7 hr/day in the dry season. Winds are stronger from June to September and weaker from December to March with the average wind velocity of 4.8 km/hr. Tables 1.1 and 1.2 show monthly rainfall record at the Sila station and climate data at the Godo station, respectively.

The Ntonggu river rises in the mountain area where the altitude is approximately 700 m and follows a westerly course. It then flows into the Karanu river which flows westwards and discharges into Bima Bay. The surface of the catchment area is mostly covered with forest. The catchment area at the proposed Embung site is 6.2 km^2. There is no gauging station on this river.

1.3 Geology

The proposed Embung site is underlain by mainly volcanic rock of the Tertiary and unconsolidated deposits of the Quaternary. The geological formation is: dacitic lava and breccia composed of dacita to dacitic breccia of the Tertiary age, being moderately hard to hard rock; terrace deposits composed of mainly sand and gravel, forming terrace with flat to gentle slope; alluvium composed of sand, silt and gravel forming lowland; detritus composed of soil with rock fragments and distributed at foot of slope or gentle valley; and, river deposits composed of sand, silt, gravel and boulder, and distributed along the existing river bed.

1.4 Soils and Land Use

The Project area of Ntonggu II is located in the bottom of U-shaped valley and the alluvial fan. The north and east boundaries of the Project area are mountain ranges making the valley. The Ntonggu river runs in the center of the valley from east to west and the Bombo river runs on the southern border of the Project area. The land slope of the bottom area is about 1 to 2 %.

Soils of the Project area extend on basaltic rocks or alluvial materials. Soil drainage of farmland is well to poor and soil permeability is slow to moderate. Soil depth is very deep recording more than 100 cm. Soil texture of surface soil varies from clay to sandy loam.

The results of the soil survey are shown in Table 1.3 on a typical soil profile out of 14 soil test pits, Table 1.4 on soil laboratory tests for soil samples taken from three representative pits out of 14 pits and Table 1.5 on the soil classification.

Most of the valley bottom area is used as the wet paddy field, covering 393 ha in total. The gentle slope area on the northern range is the dry upland field covering 54 ha. The steep hill slope areas in the north and south remain as bush/scrub covering 95 ha.

In the Project area, there are three intake weirs of which two are on the Ntonggu river and another is on the Bombo river. The total area of the irrigated paddy field is 321 ha, comprising 71 ha in the right bank area of the Ntonggu river, 40 ha in the left bank area of the Ntonggu river and 210 ha in the right bank area of the Bombo river. The remaining 72 ha of the wet paddy field are still under the rainfed condition.

The present land use is classified on the 1/5,000 topographic map and it is summarized below.

Present Land Use on the Project Area of Ntonggu II

Unit: ha

Land Use	Irrigated	Rainfed	Others	Total
Paddy field	321	72		393
Upland	0	54		54
Tree crops	0	0		0
Bush/Scrub/Grassland			95	95
Residential			36	36
Cemetery			2	2
Others			3	3
Total	321	126	136	583

Source : The JICA Study Team

The present land use and soil classification of the Project area are illustrated in Figure 1.1.

1.5 Demography

The demographic condition in the Project area as of 1993 is revealed by a total population of 2,307 and a total number of households of 424 including farm households of 412 as shown below. The average family size is 5.4 persons. Dominant ethnic is originated from Bajonese and the majority of inhabitants embrace Islam religion. Their education attainment is commonly primary school grade.

Present Demographic Condition

Village	Sub-Village	Total Population (person)	Total Household (No.)	Family Size (person)	Farm Household (No.)
Ntonggu II	Wudu Udu	2,307	424	5.4	412

Source : JICA Water Use Survey

1.6 Domestic Water Use

Available water source facilities are dug and pump wells for supplying domestic water and river flow and dug wells for getting livestock water in the Project area. The present water use in each sub village clarified under the Study is summarized below:

- In Wudu Udu Sub Village, there are 18 pump wells and 12 dug wells both used as drinking water sources nearby inhabitants' houses. Among these, eight hand pump wells are presently broken. Breeding households depend their livestock water on dug wells and the Ntonggu river flowing nearby the village. The length of prevailing water shortage period is five months from August to December for drinking and livestock water.

1.7 Social Infrastructures

The access from Mataram, the provincial capital of NTB, to the Project area is the Mataram-Labuhan Lombok road, Lombok-Sumbawa ferry between Labuhan Lombok and Alas, and trans-Sumbawa road. The proposed Embung site is linked by a gravel road with the trans-Sumbawa road. The existing rural electrification network has already been extended to the Project area.

Inhabitants are generally using private toilets outside their houses for defecating purposes. There are an integrated health service center within the Project area and an auxiliary hospital 3.0 km away.

1.8 Agriculture and Livestock

(1) Present cropping pattern and intensity

The average annual planted areas of major crops are summarized below.

Present Cropping Pattern and Intensity

Cropping Pattern	Net Area (ha)	Planted Area (ha)	Proportion of Planted Area (%)	Cropping Intensity (%)
(1) Paddy - Palawija	233.0	289.0	71.7	124
(2) Paddy - Fallow	65.0	65.0	16.1	100
(3) Upland crop - Fallow	49.0	49.0	12.2	100
Total / Average	347.0	403.0	100.0	117

Source : The JICA Land Use Survey and Inventory Survey

(2) Farming practice and farm inputs

About one fourth of the irrigated paddy field, farmers practice two cropping of the irrigated wet season paddy and the rainfed dry season soybean and groundnut as Palawija crops. Single cropping of the wet season paddy predominates on the remaining irrigated and rainfed paddy field. Maize is grown on dry upland.

As for paddy, most farmers carry out land preparation with an animal-drawn plough and harrow their paddy field once or twice at the beginning of the wet season, while this work done by other marginal farmers depends on their own man power. High yielding rice varieties such as IR36, IR64 and Krueng Aceh are grown. Rice seed is sown on a nursery bed of which area is in the ratio of one twentieth against the main paddy field. Manual weeding is usually made one to three times throughout the rice growing period. Harvesting

is carried out by using a sickle and hand threshing is conducted by beating rice plants against a frame.

Common farming practices of Palawija and upland crops are very simple and local varieties are broadly used. Land preparation, planting, weeding and harvesting are done by hand.

Farm inputs and labor requirements currently used for growing these crops are given below.

Present Farm Inputs and Labor Requirements

Description	Unit	Wet Paddy	Soybean	Groundnut	Mungbean
Farm Inputs					
Seed	kg/ha	50	50	60	25
Fertilizer					
Urea	kg/ha	300	50	50	50
TPS	kg/ha	100	100	100	0
KCl	kg/ha	50	25	25	0
Agro-chemicals	lit/ha	-	-	-	-
Labor Requirements					
Nursery	md/ha	4	-	-	-
Land preparation	md/ha	2	3	10	3
	ad/ha	5	-	-	-
Planting	md/ha	3	3	4	3
Transplanting	md/ha	15	-	-	-
Weeding	md/ha	10	4	4	3
Pest & disease control	md/ha	2	2	2	12
Farm management	md/ha	2	2	2	2
Harvesting	md/ha	15	10	10	12
Transportation	md/ha	5	5	5	6
Others	md/ha	4	2	2	2
Total	md/ha	62	31	39	32
	ad/ha	5	-		-

Source : The JICA Farm Economy Survey

(3) Crop yield and production

The present crop yield and production in the Project area are estimated as shown below. Unit yield of major crops remains extremely low due to the shortage of irrigation water, insufficient farm input supply and traditional farming practices.

Present Crop Yield and Production

Crops	Planted Area (ha)	Unit Yield (ton/ha)	Production (ton)
Wet Paddy Field			
Irrigated			
Wet season paddy	289	3.00	867
Rainfed			
Wet season paddy	65	2.00	130
Dry season Palawija			
Soybean	50	0.60	30
Groundnut	20	1.50	30
Upland Field			
Maize	49	1.00	49

Source: The JICA Inventory Survey

(4) Livestock population

Various kinds of livestock are raised in the Project area and their numbers are given below. Cows and buffaloes play important roles in land preparation and as draft power source. Goat and sheep are raised for self-consumption.

Current Population of Livestock

Unit: head

Breeding Household	Cow	Buffalo	Horse	Goat /Sheep	Pig	Chicken/ Duck
187	115	245	26	259	0	0

Source: The JICA Water Use Survey

1.9 Irrigation Facilities

In the Project area, there exists paddy field of 89 ha in gross on the right bank and 98 ha on the left bank of the Ntonggu river. Both areas have been irrigated mainly by the existing weirs situated at around 1.1 km, 2.5 km and 3.9 km downstream of the proposed Embung site, respectively. These weirs are functioning rather well. Irrigation water taken by these weirs is led by the existing canals to the existing irrigation areas. These canals are earth-canal and functioning well. Due to the shortage of surface water of the river and poor conditions of the existing facilities, the paddy field of Project area has been irrigated in the wet season.

1.10 Agro-economy

(1) Farmers group

Farmers are members of Agricultural Cooperative (KUD). From its branch shop, they commonly purchase fertilizers and use credit services. Some farmers are also members of Village Youth Association or Village Program of Women Education. About three fourth of farmers have been memberships of Water Users' Association (P3A/HIPPA) established in 1990 for the purpose of maintaining on-farm irrigation service facilities and managing irrigation water distribution.

(2) Agricultural supporting services

Agricultural extension services are provided to farmers by field extension workers (PPL) attached to a rural extension center (BPP) in Belo. Usually, farmers receive PPL's visiting service very few because of limited budget for field operation in BPP. Some PPLs are livestock specialists to provide various services under the instructions of a specialized agricultural extension agent assigned to a district center for agricultural extension. Veterinary care services are given to breeding households through an animal health center of the Veterinary Service of the Department of Livestock. The present level of livestock extension services is similar to that of the agricultural extension services.

Credit services are available in KUD as well as in the service network of the Indonesian People's Bank (Bank Rakyat Indonesia) both handling "Credit for Farmer (KUT)" and "Income Generating Project for Marginal and Landless Farmers (P4K)". Financial sources of these credits are the Government for KUT and IFAD for P4K aiming at group financing.

Sumbawa Water Resources Development and Conservation Project Office (Proyek PKSA Sumbawa) under the NTB Provincial Public Works Service (DPUP) is responsible for new water resource development and watershed management. New development of

irrigation system is the responsibility of Sumbawa Irrigation Project Office, while upgrading and rehabilitation works are the main task of Provincial Project Office for Rehabilitation and Upgrading of Irrigation. Operation and maintenance (O&M) works of all facilities are conducted by Provincial Project Office for Operation and Maintenance (PPO&M APBD). These project offices are under the direction of DPUP.

(3) Farmers' Household Economy

The results of agro-economy survey carried out in the Project area under the Study reveal that the average income and expenditure of 15 sample farmers amount to Rp. 2.74 million and Rp. 2.77 million, respectively. Some sample farmers make up for deficit in their household economy by selling their livestock. Table 1.5 shows the summary of replies of 15 respondents.

2. DEVELOPMENT NEEDS AND CONCEPTS

2.1 Development Needs and Constraints

(1) Population increase

The future population in the Project area is anticipated by referring to "Projection of Population for Kabupaten/Kotamadya in Indonesia 1990-2000" prepared by National Statistic Bureau and the Second Long Term Development Plan (PJPT II). The total number of inhabitants living in the Project area will increase from 2,307 persons as at 1993 to 2,461 persons in 1998, 2,611 persons in 2003, 2,855 persons in 2008, 2,983 persons in 2013 and 3,100 persons in 2018.

(2) Basic human needs (BHN)

The inhabitants in the Project area are unsatisfied with the present condition of rural infrastructures because the existing 23 dug wells have not enough supply capacity to cover drinking and livestock water requirements for three months between October and December and no electricity is distributed to this area. The on-going rural electrification scheme is planned to be extended to the Project area. If these dug wells are used only to get drinking water, inhabitants will be able to secure their drinking water during the dry season. Therefore, the pressing need is to solve water shortage problems for their livestock due to lack of water sources for the above three month period.

(3) Economic development needs

All of 412 farm households have principally consumed their farm products for their own use and then sold the remaining amount to local markets. There is not much possibilities of developing manufacturing and service sector industries in and around the Project area so as to offer new job opportunities to farmers. It is therefore indispensable for promoting public investment to economic infrastructures, especially for irrigation water source facilities, which encourage farmers to improve their farming system and enable them to increase their agricultural production. Increasing farm outputs could clue farmers themselves to upgrade their living standard and to catch up with faster economic growth of other sectors and places.

(4) Inhabitants' intention to development pattern

Inhabitants in the Project area intend to use their farm land more intensive because no expansion of land holding size can be expected. To do so, they need all year-round water source facilities from which they will be able to get sufficient irrigation water for growing the dry season crops. Those who are suffering from livestock water shortage problems from October to December have to bring their cattle to far places where water is available because cattle are the staff of life for the Sumbawanese. They also intend to utilize the time presently spent to remove cattle for productive purposes. In this connection, they need permanent water source facilities which enable them to secure stable livestock water throughout a year.

(5) Development constraints

The present constraints against social upgrade and economic development in the Project area are featured by the condition that available surface runoff of the river has not been fully utilized. The reason is that the existing intake weirs established on the Ntonggu river can divert only the wet season discharge as no discharge is available in the river during the dry season. Due to such situation, no more utilization of the Ntonggu river can be expected unless countermeasures to regulate the wet season runoff are practiced.

In order to supplement insufficient livestock water during the dry season, breeding households bring their cattle to far places where perennial water is available. Such limited water resources have acted as the barrier to meet BHN and to promote development of intensive agriculture.

2.2 Development Concepts and Approach

(1) Development concepts

The existing gap of economic status between NTB and other Provinces is caused by insufficient fulfillment of BHN, slow pace of poverty alleviation and less concerns about a balanced investment to regional development. In harmony with the national policy to correct this economic imbalance, the development concept is formed aiming at improvement of social and economic infrastructures with the highest priority so as to meet BHN and increase agricultural outputs. Among others in the Project area, it is prerequisite to pay special attention to how to solve irrigation and livestock water shortage problems originated from insufficient use of potential water resources in the Ntonggu river basin.

(2) Development strategies and approach

To overcome development constraints prevailing in the Project area, water resources seasonally available are to be regulated by means of constructing Embung as the water reservoir on the Ntonggu river. Approach to development planning of the potential Embung is as follows:

- To put the first priority to supply irrigation water and the second to livestock water taking into account inhabitants' needs and intention;
- To project the future water demand for irrigation and livestock use at the target year of 2008 being the last year of Pelita VIII;
- To examine development potential of the Ntonggu II Embung from the technical viewpoints;
- To determine the optimum development scale of the Embung;
- To make preliminary design and cost estimate; and
- To conduct investment justification from the viewpoints of economic soundness, social satisfaction and environmental impact.

2.3 Land Potential

All of the existing paddy field could be irrigated from the viewpoint of the topographical condition. To irrigate the paddy field of 36 ha between the Ntonggu river and its tributary, an aqueduct is required to be installed over the river.

A part of the upland could be transformed into the irrigated paddy field in future. The newly developed area with a gentle slope from 2 to 5% is estimated at 27 ha in total.

Rainfed paddy field	->	Irrigated paddy field	72 ha
Rainfed upland	->	Irrigated paddy field	27 ha

In conclusion, the future land use plan of the Project area is offered as shown below.

Future Land Use Plan on the Project Area of Ntonggu II

Unit: ha

Land Use	Irrigated	Rainfed	Others	Total
Paddy field	420	0		420
Upland	0	27		27
Tree crops	0	0		0
Bush/Scrub/Grassland			95	95
Residential			36	36
Cemetery			2	2
Others			3	3
Total	420	27	136	583

Source : The JICA Study Team

There is the rainfed paddy field in the impounding area of the proposed Embung. The area of the impounding paddy field is estimated at 30 ha. Although the land transformation from the rainfed paddy field of 72 ha and the upland of 27 ha into the irrigated paddy field could be proposed within the Project area, this new irrigation area is not enough for the alternative land resource. Therefore, the alternative land resource need to be found in other area, or cash payment would be required for compensation.

2.4 Agricultural and Livestock Development Plan

(1) Alternative cropping patterns

In formulating the future cropping patterns in the Project area, the following basic principles have been adopted:

- Higher benefit for farmers;
- Optimum use of irrigation water;
- Practical farming system for family labor; and,
- Crops and cropping patterns acceptable to farmers.

Wet paddy is the most predominant crop in the Project area and acceptable to farmers as they have long experience in rice cultivation. Therefore, they could easily master irrigated rice cultivation methods to realize higher production and thereby large irrigation benefit under the condition of "With Project". Aiming to determine the optimum development scale of the proposed Embung, the following alternative cropping patterns are established.

Alternative Cropping Patterns

Pattern Code	Wet season		Dry season			
			First cropping		Second Cropping	
	Crop	Coverage (%)	Crop	Coverage (%)	Crop	Coverage (%)
With Project C-12	Paddy	100	Paddy	100	-	-
With Project C-22	Paddy	100	Mungbean	100	Tomato	33
					Cabbage	33
					Red onion	34
With Project C-23	Paddy	100	Paddy	100	Mungbean	100

Remarks : * ; Mixed with groundnut

(2) Farm input and labor requirements

Under the "With Project" condition, farmers who are depending on unreliable rainfall, river flow or irrigation water can be expected to get stable irrigation water supply. They will be able to increase farm inputs to the optimal level with less risk. Proposed farm inputs are estimated in consideration of the present input level in advanced irrigation areas as well as data collected from BPPs. Labor requirements are also expected to increase substantially in cultivation under the technical irrigation system. On the other hand, farm input and labor requirements are expected to remain at present level under the "Without Project" condition.

Proposed Farm Input and Labor Requirements

Item	Unit	Wet Paddy	Mungbean	Tomato	Cabbage	Red Onion
Farm Inputs						
Seed	kg/ha	25	30	14	15	2,000
Fertilizer						
Urea	kg/ha	300	75	350	350	300
TPS	kg/ha	100	100	400	400	200
KCl	kg/ha	50	50	400	400	100
Agro-chemicals	lit/ha	2	2	10	10	10
Rodenticide	kg/ha	2	1	3	3	3
Labor	md/ha	185	80	150	200	250
Draft Animal	ad/ha	20	10	20	20	20

(3) Proposed farming practices

Proposed farming practices for wet paddy are as follows:

- High yielding rice varieties to be used under the With Project condition are IR64, Krueng Aceh, Pelita, C4 and IR36 with maturing periods of 110 to 135 days. These varieties are moderately resistant or resistant to several major rice pests and diseases. Land preparation on wet paddy field has to be done by animal ploughing and harrowing;

- Fertilizers need to be applied three times; the first application at the final stage of land preparation, and the second and third applications as top-dressing at the 20th and 37th day after transplanting, respectively. The top-dressing will be applied while water depth on wet paddy field is shallow. The phosphorous (TPS) and potassium (KCl) fertilizers have to be applied at the final stage of land preparation. The required amount of fertilizers is 60 kg/ha of N, 30 kg/ha of P and 30 kg/ha of K;

- Seed rates are 20 to 40 kg/ha for nursery. The best period for transplanting is 3 to 4 weeks after sowing, when the seedlings have 5 to 6 leaves. Ratio of the nursery bed to the main wet paddy field is about one twentieth. Planting density is about 2 to 3 plants per hill and spacing of hill is 20 cm x 20 cm;

- Weeding is required to be performed two to three times during the rice growing period according to weed growth. Irrigation water supply needs to be guaranteed during the most critical stages of the plant growth such as tillering, booting, flowering and germination stages. Timely control of insects, pest and diseases is necessitated on the basis of advice by PPLs and their assistants; and

- It is desirable to carry out harvesting when the ears are nearly ripened and are still in slight green. Harvesting is made by labors using a sickle. Harvested paddy plants need to be dried on the field for 3 to 4 days.

For growing Palawija crops under the irrigated condition, advanced farming practices similar to irrigated wet paddy cultivation and high yielding varieties are to be adopted. Land preparation will require animal-draft in order to enhance efficiency and accuracy of the work. Proper fertilization matching with soil conditions and timely insect/disease control are also indispensable. These farming practices need to be applied for, following technical instructions of PPLs.

(4) Anticipated crop yield

It is anticipated that the future yield of proposed crops under the "With Project" condition increases to 4.5 ton/ha for wet paddy, 1.1 ton/ha for mungbean, 0.6 ton/ha for tomato, 30.0 ton/ha for cabbage and 7.5 ton/ha for red onion. These targets are estimated in due consideration of the present yield level in well established irrigation areas of Kabupaten Bima as well as introduction of high yielding varieties and advanced farming practices, stable irrigation water supply and optimum use of farm inputs. As for build-up period to attain the anticipated yield, it is also prospected that crop yield level is 60% of the target in the first year, 70% in the second year, 80% in the third year, 90% in the fourth year and 100% from the fifth year and onward.

(5) Projected livestock population

The future livestock population in the Project area for the target year 2008/2009 is projected as shown below taking into account the actual growth rate of each livestock in Kabupaten Bima during the Pelita V period.

Projected Population of Livestock

Unit: head

Cow	Buffalo	Horse	Goat /Sheep	Pig	Chicken/ Duck
299	99	7	141	0	0

2.5 Water Demand

(1) Livestock Water Demand

The future livestock water consumption level in NTB is set to be 40 lit/day/head for cow, buffalo and horse, 5 lit/day/head for sheep and goat, 6 lit/day/head for pig and 0.6 lit/day/head for poultry according to "The Study for Formulation of Irrigation Development Program in the Republic of Indonesia". Additional water demand for buffalo's bathing is considered to be 20 lit/day/head.

Following the future livestock population projected, the future livestock water demand is estimated to be 6,900 m^3. The breakdown of this livestock water demand is 4,400 m^3 for 299 cows, 1,400 m^3 for 99 buffaloes, 100 m^3 for 7 horses and 300 m^3 for 141 chickens as well as 700 m^3 for bathing water of buffaloes.

(2) Irrigation water demand

In order to optimize the development scale and delineate the beneficiary area of the Project, irrigation water demand for each proposed crop is estimated for unit irrigation area of 1 ha on the semi-monthly base taking into account crop consumptive use, evapotranspiration, crop coefficient, effective rainfall and irrigation efficiency both for wet paddy and Palawija crops as well as land preparation water, layer replacement and percolation loss only for wet paddy. As described in Attachment 1, irrigation water demand

in the Project area is calculated by referring to the standard quoted in "Irrigation Design Standard, KP-01" by DGWRD.

Tables 2.1 and 2.2 show the calculation results of evapotranspiration and effective rainfall, respectively, and Table 2.3 presents the unit irrigation water demands for each crop.

3. EXAMINATION OF EMBUNG DEVELOPMENT POTENTIAL

3.1 Topographic Condition

The Ntonggu II Embung site is selected in the upstream side on the basis of comparative/ alternative study for the upstream and downstream sites. River bed elevation at the proposed Embung site shows El. 53.0 m and the width of valley is 260 m at El. 70.0 m on both abutment of the dam site. Gradient of the river bed around the proposed Embung site is gentle as 1/160 in comparison with the upstream of the Ntonggu river.

3.2 Geological Condition

The proposed Embung site is underlain by dacitic tuff breccia and alluvium. The foundation is mainly formed of dacitic tuff breccia on the both left and right banks, and alluvium at river bed. The drilling survey shows that the N-value of alluvium is ranging from 6 to 31. The coefficient of permeability varies from 5.1×10^{-5} to 9.8×10^{-6} cm/sec for alluvium and from 2.6×10^{-4} to 1.1×10^{-5} cm/sec for dacitic tuff breccia. Ground water is present at 0.6 to 3.0 m deep in alluvium.

The reservoir area is mainly underlain by dacitic tuff breccia, terrace deposits and alluvium. No major fault and landslide are recognized in the reservoir area. However, some lineation supposed to the fault are recognized by interpretation of aerial photographs. Geological map and profile are shown in Figures 3.1 and 3.2.

3.3 Availability of Construction Materials

In and around the proposed Ntonggu II Embung site, there are sufficient materials suitable for constructing a homogeneous earthfill dam. The borrow area for impervious soil and the quarry site for sand and gravel materials are investigated from the technical and economical viewpoints. The following shows a summary of the selected location and the availability of the materials.

Availability of Construction Materials

Material	Location	Description
1. Impervious soil	Reservoir area and downstream of the dam site	Clayed sandy silt estimated to be more than 300,000m^3
2. Drain material	Ntonggu river	Sand & gravel from river deposits
3. Toe rock material	Ntonggu river	Boulders from river deposits
4. Concrete aggregates	Ntonggu river	Sand & gravel from river deposits

3.4 Availability of Water Resources

(1) Catchment yield

As for the river where the Ntonggu II Embung will be constructed, there is no record of discharge. Accordingly, runoff at the proposed Embung site is estimated by use of the rainfall record near the site. The Sila rainfall station which is located in the west of the Ntonggu II Embung catchment has rainfall record of nearly consecutive 23 years and is considered to represent catchment rainfall. The blank data of the Sila station was

supplemented by that of the Raba station. The climate is strongly influenced by altitude and the rainfall in the low elevated area is considerably low comparing to the high elevated area. Furthermore, most rainfall stations are located in the low elevated area. To convert the station rainfall to the catchment rainfall, the adjustment coefficient of 1.3 is multiplied by use of isohyetal map. The generated catchment rainfall is given in Table 3.1. A runoff coefficient of 0.35 is adopted considering the characteristics of the catchment area and the previous hydrological analysis in the Sumbawa Island. Using this runoff coefficient and rainfall record at Sila, river flow at proposed site is estimated.

The following conditions are considered for estimation of the half monthly discharge:

- Catchment area of the proposed Embung site is 6.2 km^2; and,
- Less than 20 mm of half monthly rainfall is ignored for estimation.

This estimation is made based on the rainfall record from 1970 to 1990. The estimated half monthly discharge is given in Table 3.2 and monthly discharge is summarized below.

Mean Monthly Discharge

Unit: 1,000 m^3

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
596	572	414	135	55	32	7	0	19	86	310	524	2,750

(2) Floods

The flood analysis is made to determine the design discharge of the structures, such as spillway, diversion tunnel, and so on. Taking availability of the flood record and size of the catchment area into account, the rational formula is adopted to estimate the flood discharge in the Study. The formula is;

$$Q = 0.2778 \, f \, r \, A$$

where, Q : Peak discharge (m^3/s)
f : Runoff coefficient
r : Average rainfall intensity within time of concentration (mm/hr)
A : Catchment area (km)

1) Design rainfall

Design rainfall is estimated by the Log Pearson Type III method, which is widely used in NTB. In this Study, 20 years rainfall data of the Sila station from 1970 to 1993 are analyzed by the method. The result of probability analysis is summarized below.

Design Rainfall

Unit : mm

Return Period	Design Rainfall
1 in 2 year	79
1 in 5 year	98
1 in 10 year	109
1 in 20 year	120
1 in 50 year	133
1 in 100 year	143
1 in 200 year	152

2) Design flood

The following is the Ruziha's formula to estimate the flood travel time:

$$T = L/V$$

$$V = 72(H/L)^{0.6}$$

where, T : Flood travel time (hr)
L : Horizontally projected length of river course (km)
H : Difference of elevation (m)
V : Velocity of flood (km/hr)

The rainfall intensity within concentration time of the flood is estimated by an empirical formula prepared by Dr. Mononobe as follows:

$$r = (R_{24}/24) \times (24/T)^{2/3}$$

where; r : Maximum average rainfall intensity within concentration time (mm/hr)
R_{24} : Daily rainfall (mm)
T : Time of concentration (hr)

The runoff coefficient is estimated at 0.8 considering the condition of the catchment area.

Based on the above condition, the peak floods in various return period are estimated. The result is shown in Table 3.3 and summarizes below.

Probable Flood

Unit : m^3/s

Return Period	Probable Flood
1 in 2 year	54
1 in 5 year	67
1 in 10 year	75
1 in 20 year	82
1 in 50 year	91
1 in 100 year	98
1 in 200 year	104

(3) Sediment load

There is no available data on sediment load on the river, where the Ntonggu II Embung will be constructed. The Technical Report I (Embung Study Program) in the Sumbawa Water Resources Development Planning Study Extension Phase in 1982 indicates that the sedimentation rate is 0.5 mm/year/km^2 . Taking data availability and characteristics of the catchment area into account, 0.4 mm/year/km^2 is adopted in this Study.

(4) Water quality

On October 28, 1994, water samplings were carried out at the proposed Embung site and upstream and downstream of the site for the clarification of the water quality. The result of the test is shown in Table 3.4.

4. EMBUNG DEVELOPMENT PLAN

4.1 Optimization of Development Scale

The water balance study aims to clarify the relationship among the proposed Embung scale, irrigable area and cropping pattern. According to the water demand and procedure to be described below, the water balance study of the Pelangan Embung Project is conducted.

(1) Methodology

The simulation equation is as follows:

$$W_2 = W_1 + I - L - S_P - O_D - O_L - O_I$$

where , I : inflow to reservoir at the half monthly period (m^3)
L : water losses from the reservoir caused by evaporation during the half monthly period (m3)
SP : flow of water over the spillway during the half monthly period (m3)
OD : outflow needed for domestic water during the half monthly period (m3)
OL : outflow needed for livestock water during the half monthly period (m3)
OI : outflow needed for irrigation water during the half monthly period (m3)
W_1 : volume of water in the reservoir at the beginning of the half monthly period (m^3)
W_2 : volume of water in the reservoir at the end of the half monthly period (m^3)

1) Inflow

Since there is no gauging station on the Ntonggu river, discharge is generated from rainfall of the Sila station.

2) Reservoir storage curve

Reservoir storage curve with surface area is shown in Figure 4.1 in relation to the elevation at the proposed Embung site.

3) Losses

Evaporation from inundation area can be estimated as "1.1 x ETo", indicating, "open water evaporation", which is employed in the Design Criteria KP-1.

4) Spill out discharge from reservoir

Spill out discharge is considered if there is any excess storage which exceeds the maximum storage capacity of dam.

5) Water Demand

The 100% dependability of the above demand shall be secured by the proposed Ntonggu II Embung.

To meet 80% dependability of irrigation water, reservoir capacity will be determined.

6) Water level of reservoir

Minimum water level is estimated at El. 58.3 m considering sedimentation volume for 25 years and 1.0 m allowance. Maximum water level for the simulation is equal to the crest elevation of spillway

(2) Optimum development scale

The optimum development scale of Ntonggu II Embung coincides with the maximum scale which can be decided by the available run-off from the catchment area at the proposed Embung site. From the hydrological viewpoint, the Embung height is unable to go beyond 17.0 m. The optimum development scale is thus in line with the height of 17.0 m and effective storage capacity of 1.159 MCM. The result of the reservoir operation is shown in Figure 4.2.

4.2 Delineation of Beneficiary Area

(1) Delineation of beneficiary irrigation area

By developing available water resources of the Ntonggu river through construction of the proposed Ntonggu II Embung at the scale to utilize the maximum runoff, irrigation water can be supplied to wet paddy field of 187 ha in net for the wet season and 65 ha for the dry season. The beneficiary area of the proposed Embung comprises the presently irrigated paddy field of 122 ha and the existing rainfed paddy field of 65 ha. Taking such limited water supply condition into account, the future cropping pattern under the "With-Project" condition needs to be revised to two cropping of the fully irrigated wet season paddy and the dry season mungbean both irrigated and rainfed as shown below and illustrated in Figure 4.3.

Under the "Without-Project" condition, no new irrigation water source can be developed so that the future cropping pattern is to remain in the same condition of the present pattern.

Future Cropping Pattern

Condition	Wet season			Dry Season		
	Crop	Water Supply	Area (ha)	Crop	Water Supply	Area (ha)
With Project	Paddy	Irrigated	187	Mungbean	Irrigated	65
				Mungbean	Rainfed	122
Without Project	Paddy	Irrigated	122	Soybean	Rainfed	10
	Paddy	Rainfed	65	(Fallow)		-

(2) Delineation of beneficiary area for livestock water supply

With regard to livestock water demand in the Project area, it is possible to meet the whole amount by using excess reservoir water of the proposed Embung. Thus, the livestock water for 423 equivalent heads of cow is to be distributed by installing new water pipeline networks.

4.3 Embung Development Plan

Following the results of the geological and material surveys as well as the optimization study, the proposed development plan of Ntonggu II Embung is determined. In terms of dam type, homogeneous earth type is applied in due consideration of the foundation strength and the availability of embankment materials.

The main components of Ntonggu II Embung are the main dam, spillway, river diversion conduit and water supply facility as shown in Figure 4.4. In order to provide the reservoir with the optimum storage capacity of 1.159 MCM in the reservoir, the full supply level (F.S.L.) is set at El. 66.0 m. Taking overflow depth of spillway and freeboard into account, the dam height of Ntonggu II Embung becomes 17.0 m above the river bed. In order to release the flood discharge during the construction period, an open river diversion is provided. The spillway is designed on the left bank of the main dam to release the flood discharge of 106.0 m^3/sec from the catchment area of 6.2 km^2. For the purpose of supplying domestic water to the beneficiary area, such related facilities are provided as an intake structure in the reservoir, water supply pipe with a diameter of 300 mm below the dam body and valve house at the downstream of the main dam.

The principal features of Ntonggu II Embung are summarized below.

(1)	Reservoir	
	- Catchment area	6.2 km^2
	- F.S.L.	El. 66.0 m
	- Minimum operating level	El. 58.3 m
	- Effective storage capacity	1,159,000 m^3
	- Dead storage capacity	111,000 m^3
	- Gross storage capacity	1,270,000 m^3
	- Sediment deposition level	El. 57.3 m
(2)	Main dam	
	- Type	Homogeneous earthfill dam
	- Height	17.0 m above river bed
	- Crest elevation	El. 70.0 m
	- Crest length	260 m
	- Crest width	7.0 m
	- Upstream slope	1 : 4.5
	- Downstream slope	1 : 3.0
	- Total embankment volume	252,000 m^3
(3)	Spillway	
	- Design flood (1/100 year)	106 m^3/sec
	- Type	Overflow weir
	- Crest elevation of overflow weir	El. 66.0 m
	- Width of overflow weir	20.0 m
	- Discharge capacity	110 m^3/sec
	- Overflow depth	2.0 m
	- Length	160 m
(4)	River diversion	
	- Design flood (1/5 year)	73 m^3/sec
	- Type	Open channel
	- Diameter	10.0 m x 4 m
	- Length	170 m
(5)	Water supply system	
	- Inlet structure	1.0 x 1.0 m square with trash racks
	- Pipe diameter	ϕ 300 mm pipe culvert
	- Length	140 m
	- Design discharge	200 lit/sec.
	- Valve house	Right abutment of dam site
	- Type	Through valve

-	Diameter	ϕ 300 mm
-	Outlet elevation	El. 57.0 m

5. PRELIMINARY DESIGN OF FACILITIES

5.1 Preliminary Design of Embung

(1) Dam height

Resulting from the optimization study based on irrigation benefit and the construction cost, the dam height is decided on the basis of "Reservoir Storage Curve" as shown Figure 4.1.

(2) Freeboard

The freeboard of main dam is designed taking into consideration the rise of reservoir water surface due to extraordinary flood discharge and wave uprush on the slope.

The following formula is applied for the design of the Ntonggu II Embung.

$$Hf = 0.05h + 1.0 \text{ (m)}$$

where, Hf : freeboard
h : height from river bed to the designed flood level.

(3) Horizontal filter drain and toe rock drain

In order to reduce the seepage line within the dam body under the full reservoir water condition, horizontal filter drain (drainage mattress) and toe rock drain are provided below body and at toe portion of the main dam as shown in Figure 4.4.

(4) River diversion tunnel during construction

During the dam construction period, river flow including floods has to be diverted to avoid inundation of the Embung construction site. This can be effectively and economically made by providing a random-filled cofferdam and an open channel river diversion with a trapezoidal shape of 10 m in width and 4 m in height. A 5-m high cofferdam with a crest level of El. 58.0 m would suffice to contain the flood inflow of 73 m^3 /sec having a return period of five years.

(5) Spillway

The spillway is located on the left abutment of main dam, which is composed of overflow weir and chuteway. The over flow weir is designed to cope with the inflow design flood with a flood surcharge space provided above F.S.L. The inflow design flood is determined at 100 year probable flood having a peak discharge of 106 m^3/sec.

Base on comparative study on combination of overflow depth and width of the spillway, the overflow depth at 2.0 m and the width of 20.0 m are decided so as to minimize the costs of the spillway and the main dam.

A non-gated ogee crest would be set at El. 66.0 m to coincide with F.S.L. A bridge would be provided over the throughway of the spillway.

(6) Water supply system

In order to supply the water to the downstream irrigation area, the water supply system is provided to release the water of 200 lit/sec. The water supply system consists of intake structure, pipe line and valve house. The intake structure is located at the front of

diversion tunnel above the sediment deposition level of El. 57.3 m. Fixed trashracks are provided on the intake structure. Pipe culvert with diameter of 300 mm is connected from the intake structure to the downstream through the main dam foundation.

A value house would be constructed near the downstream toe of the dam. The guard valve and control devices with a diameter of 300 mm would be installed in the valve house.

5.2 Preliminary Design of Irrigation Facilities

(1) Basic concept

The following basic concepts are applied for the preliminary design of irrigation facilities in line with the development strategy:

- Irrigation water impounded by the Embung is supplied firstly to the existing cropped field, irrigated or rainfed, in the beneficiary area;
- Irrigation area is defined taking into consideration the available cropped field and the effective storage capacity of Embung;
- Irrigation canals from the outlet of Embung to the head of existing cropped field is constructed in the form of open channel as much as possible from the economic viewpoint;
- Irrigation system in the existing cropped field is be developed by farmers themselves, as the irrigation system commands around 50 ha only. No consideration is taken into in terms of new land reclamation;
- Proper design of canal alignment for gravity irrigation is considered paying special attention to avoid adverse effect on environment; and,
- Drainage improvement is not required for the existing cropped field since the beneficiary area is situated on well drained land.

(2) Irrigation plan

The outlet works of the Embung are planned to be used for dual purposes of supplying irrigation and domestic water. The water taken from the reservoir is led to the valve house through the cast iron pipe provided in the left abutment of the dam.

Irrigation water is discharged to the irrigation inlet box to make the open flow from the pipe pressure flow. From the irrigation inlet box, irrigation water is led to the existing irrigation field by newly constructed open channel. On the way, livestock water is diverted.

General layout is shown in Figure 5.1 including the layout of irrigation canals.

(3) Design discharge and initial water level

Design discharge for canal and related structures are decided based on the irrigation water requirement and proposed cropping pattern. Peak semi-monthly base diversion requirement for the unit irrigation area of 1.0 ha is defined as a design discharge after multiplying the irrigation area. Peak diversion requirement occurs in the first half month of January for the wet season paddy crop and its design discharge is estimated at 200 lit/sec for the net irrigation area of 187 ha. This design discharge is enough to flow design discharge for the dry season Palawija crops of net area of 187 ha at peak time.

Initial water level at the irrigation inlet box is decided taking into consideration the elevation at the box. As a result, the initial water level is El. 57.0 m at the irrigation inlet box.

(4) Irrigation facilities

The proposed canal layout and design of irrigation facilities are made based on the 1/5,000 topographic map prepared under Study and in accordance with the following considerations:

- Canal alignment is to be straight and short as much as possible;
- The alignment is to be planned pass outside villages and give no damages to public facilities;
- The types of canal related structures are to be minimized as much as possible; and,
- The structures are to be simplified as much as possible.

Irrigation canal to lead the water to the wet paddy field from the Embung is constructed as a stone masonry trapezoid canal taking into account the design discharge of the canal, steep topographic condition, construction method and available construction materials in the Project area. Canal related structures required are irrigation inlet box, turnouts, siphon, cross drain and irrigation division boxes. Required irrigation facilities are summarized below.

Irrigation Facilities Requirements

Facilities	Quantities
- Valve house (including in the facilities for Embung)	1 No.
- Irrigation inlet box	1 No.
- Masonry canal to be constructed	5.4 km
- Turnout	2 Nos.
- Siphon	1 No.
- Aqueduct	1 No.
- Cross drain	1 No.
- Irrigation division box	54 Nos.
- Division box for livestock	14 Nos.

5.3 Preliminary Design of O & M Road

No all weathered road is available in and around the Embung site. It is therefore planned to provide O&M road to the dam site aiming at smooth undertaking of O&M works after completion of the Embung. Main features are summarized below.

Main Features of O&M Road

Item	Unit	Quantities
Required length	km	0.98
Width	m	7.0
Pavement		Gravel

6. EMBUNG CONSTRUCTION PLAN

6.1 Construction Schedule

(1) Basic condition

All the construction works will be carried out by a local contractor selected by local competitive bidding.

The construction plan is based on the mode of construction and the target schedule of construction works as well as local conditions such as availability of construction labor, material and equipment, as well as weather and topographic conditions of the construction site.

It is assumed that 200 working days per year are available for conducting the earthfill embankment works, 270 days per year for the filter and rock embankment works and 300 days per year for concreting works in view of the daily rainfall distribution in the Project area. For each working day, 8-hour shift is applied.

(2) Construction schedule

The overall construction schedule is determined as shown in Figure 6.1 taking into account the necessary time of detailed design, bidding procedure including the time of tender evaluation and award of the contract. The major points of construction schedule are described below.

1) Mobilization and preparation works

Immediately after received the "Notice to Proceed", the contractor would commence the mobilization of the construction equipment and key staffs to the site from beginning of November in the first year. Following the above, preparatory works would be commenced at the Project site.

2) Setting out and excavation works

During the mobilization, setting out of all the structures would be commenced by the contractor at the Project site. Construction of temporary access roads such as access to the borrow area and access to major structural sites shall be started by using equipment available at the Project site. The excavation works for the river diversion channel and the main dam would be commenced at the beginning of March in the second year.

3) Embankment works and excavation of spillway and water supply conduit

After the river water divert into the diversion channel around June in the second year, embankment works for the main dam shall be commenced and completed before the rainy season in the third year. Excavation works for the spillway and water supply conduit shall also be commenced and completed before October in the second year.

4) Concrete works of spillway and water supply conduit

Concrete work of the spillway will be commenced in March and completed before October in the third year. Concrete works of the water supply conduit will be completed before re-starting the embankment of the main dam in the dry season in the third year.

5) Commencement of reservoir water impounding

Commencement of the reservoir water impounding will be done at beginning of October in the third year after completion of the main dam embankment and spillway construction. Considering the rainfall in November and December in the third year, the Ntonggu II reservoir would be quite full, the water can be supplied from the reservoir to the water users from January in the fourth year.

6) Water distribution system

Construction works for the water distribution system will be executed in parallel with the Embung construction works by using mainly manpower because the work quantities are not so much. These works shall be completed by the end of December in the third year before supplying the reservoir water to the beneficiary area.

6.2 Construction Plan of Embung

(1) Preparatory works

The preparatory works consist of preparation of temporary buildings, construction plant and repair shop, arrangement power and water supply systems as well as communication system, construction of access and haul roads, and so on. All of these works will be conducted from November in the first year to February in the second year.

1) Temporary buildings and yards

The temporary buildings required for the construction would include office, quarters, workshop, warehouse and storage yards. These temporary buildings will be built by the contractor.

2) Water and power supply

The water required for the construction works and the daily use in the construction camp is planned to be taken from the rivers or springs near the Embung site or the wells drilled in the contractor's yard.

The electric power for the construction camp is planned to be supplied by the contractor's diesel generators.

(2) River diversion works

The river flow will be released through the river diversion channel during the second and third year, which is provided along the right bank of the Ntonggu river.

In the dry season of the third year, the river diversion channel below the main dam will be filled by the embankment materials of the main dam. In this period, the river water shall be released to the downstream through the water supply pipe culvert to be constructed below the dam foundation.

(3) Main dam works

Following the foundation excavation and completion of the river diversion channel, the embankment works will be commenced at the beginning of July in the second year. Considering a total embankment volume of 252,000m ^{3} and the dry season in the second and

third year the daily embankment volume is to be 800m^3 which is quarried from the borrow area around the Embung construction site.

(4) Spillway construction

Excavation of the spillway will be scheduled to be performed for about five months from March to September in the second year. Most of the excavated materials may be used for the main dam embankments so that the excavated material will be stocked on the designated area.

After completion of the spillway excavation, concrete works for overflow weir and chuteway will be commenced. Before starting the reservoir water impounding at the beginning of October in the third year, major concrete works of the spillway shall be completed in order to release the flood discharge in the following wet season.

(5) Water supply system

Inlet structure of the water supply system is constructed above the sediment load disposition level of El. 57.3m in the reservoir area. Connecting with the inlet structure, pipe culvert with a diameter of 300 mm is constructed up to the downstream end of the main dam. Construction of the water supply conduit should be completed before re-starting the main dam embankment at the beginning of March in the third year.

The valve house of the water supply system will be constructed before the reservoir water breaches to F.S.L. of El. 66.0m around the end of December in the third year.

6.3 Construction Plan of Irrigation Facilities and O&M Road

Since the irrigation facilities and O&M road to be constructed are rather small in work quantities and scattering in the beneficiary area in comparison with the Embung construction works, almost all the works except earth works for irrigation canal and road will be basically executed by manpower. Earth works for the irrigation canal and road such as clearing, stripping, excavation and embankment works for the canal and road will be executed by using heavy construction equipment including bulldozer, excavator, compactor , and so on. All of these works will be executed in parallel with the Embung construction works.

6.4 Institutional Arrangement for Project Implementation

(1) Responsible organization for Project implementation

In the course of Project implementation, DPUP of NTB, after getting approval from DGWRD, will direct the PKSA Sumbawa Project Office to commence undertaking of detailed investigation work of the Ntonggu II Embung. This work will be done by the Survey Section of the said Project Office. Under the PKSA Sumbawa Project Office, the Sub Project Office in charge of East Region of Sumbawa will be responsible for carrying out detailed design work. Based on the cost estimate, DPUP of NTB will disburse budget for land acquisition and construction of Embung and related facilities to the Project Office using development budget allocated from the Central Government. Before starting construction work, land acquisition work will be carried out by the Land Acquisition Section of the Project Office. Supervision of construction works, being entrusted to a contractor through tendering, will be the responsibility of the said Sub Project Office.

(2) Technical resources input

In due consideration of the current availability of engineers and technical staff as well as the annual development target in the PKSA Sumbawa Project Office, it is necessary to utilize technical resources outside the Project Office to the maximum extent for enabling the Project Office to realize its target. In this connection, undertaking of detailed investigation and design works for the Ntonggu II Embung need to be entrusted to consultants aiming to secure smooth implementation of the Project in accordance with the implementation program made by the Project Office.

(3) Organization for O&M

After completing all of the Project works for Ntonggu II Embung, DPUP of NTB will submit its completion report to the Minister for Public Works through DGWRD and therefrom the notice of Project completion will be transferred to the Minister for Home Affairs. After receiving the Minister's direction, the Governor of NTB Province will order DPUP of NTB to take a necessary action for O&M of the said Project facilities. Following this, DPUP of NTB will direct its Provincial O&M Project Office to arrange O&M works and disburse the Provincial Government's budget to DPUP Kabupaten Bima Office.

(4) Water User's Association (P3A)

In the Project area, the existing P3A has been active since 1990. It is therefore necessitated to make the new beneficiary farmers become members of this P3A and to train them by using training materials and modules prepared by the Water User Training Program under DGWRD.

7. COST ESTIMATE

7.1 Basic Assumption of Cost Estimate

Project cost of the proposed works for developing the Ntonggu II Embung is estimated on the basis of assumptions as follows :

- All the civil works of the Project will be executed on the contract basis. Contractor(s) will be selected through the competitive bidding;
- Project cost includes the physical contingency of 15% of the construction costs in view of the preliminary nature of the estimate. The price contingency of 20% is also included in the cost estimate taking into account the recent price escalation of construction materials in Indonesia;
- The associated costs to be financed by the Government, such as the cost for strengthening the extension services, facilities of the Water Users' Association and improvement of the social infrastructures except for those included in the proposed Project works, are not included in the cost estimate;
- The direct construction cost is estimated based on the calculated work quantities of the Project works and unit prices of the works. The unit prices of the works are estimated based on the current prices in NTB as of October 1994 and the data collected from the on-going projects in NTT and NTB. The basic prices for construction works include delivery cost of construction materials to the Project site;
- The contract tax, which is a value added tax imposed by the government at a rate of 10% against the total contract cost, is included in the estimate of the Project cost;
- Engineering service cost for the consultants in conducting detailed design and construction supervision is estimated based on such assumption as 15% of direct construction cost;
- Administration cost consists of PRWS's staff salary for construction management, vehicle running cost and other related cost only for the Project implementation. Administration cost is estimated at around 5% of the direct construction cost with reference to the recent other project costs in NTT and NTB;
- Land acquisition cost including the purchase of the Embung site, reservoir area, borrow areas, and land of pipe line, irrigation canal and permanent structures and is estimated at 0.5 % of the direct construction cost taking into consideration the present condition of the Project area based on the survey results under the Study; and,
- The currency for cost estimate is expressed in Indonesian Rupiah (Rp.) since all construction materials are available in Indonesia and the payment for construction works will be executed with Indonesian Rupiah.

7.2 Construction Cost

The Project cost, as an initial investment by the Project, is composed of direct construction cost, administration cost, engineering service cost, physical contingency,

contract tax, land acquisition cost and price contingency. The total Project cost for constructing the Ntonggu II Embung is estimated at Rp. 11,229 million as shown in Table 7.1. Detail of direct construction cost estimated based on the calculated work quantities of the proposed Project works and unit prices of the works is shown in Table 7.2 together with work quantities of the main work items and unit prices.

The total Project cost for constructing the Ntonggu II Embung is summarized below.

Summary of Project Cost for Ntonggu II Embung

Unit : Rp. Million

Item		Project cost
I.	Direct construction cost	6,165
1.1	Preparatory works	294
1.2	Embung construction	5,389
1.3	Irrigation facilities	425
1.4	Domestic water supply	0
1.5	Operation & maintenance road	57
II.	Administration cost	308
III.	Engineering services	925
IV.	Physical contingencies	1,110
V.	Contract tax	820
VI.	Land acquisition	31
VII.	Price contingency	1,872
	Grand Total	11,229

7.3 Operation and Management Cost

The O&M costs consist of salaries of O&M staff, cost for maintaining the Project facilities, material and labor cost for repairing works, and running cost of Project facilities. The annual O&M costs are estimated at Rp. 56.1 million, which is equivalent to 0.5 % of the Project cost.

8. PROJECT JUSTIFICATION

8.1 Satisfaction of BHN

The benefit of livestock water supply to 423 equivalent heads of cow fed by beneficiary breeding households in Ntonggu II Village could be indicated as the net value of additionally increasing cattle weight, either cow or buffalo, attributable to stabilized livestock water supply condition. In order to estimate this net value, it is assumed that a cow or buffalo aged 1.5 to 2 years old and with the initial weight of 200 kg will get an additional increase of 0.6 kg/day in weight during four months of the dry season as a result of stable supply of livestock water. Further assumptions made for other unit values are Rp. 2,500/kg for the both initial and increasing weights, Rp. 490,000/head for the overall feeding cost and Rp. 24,000/head for by-products.

The direct construction cost is broken down into the cost for Embung, dam O&M road and preparatory works of Rp. 5,740 million and irrigation facilities of Rp. 425 million. The annual water demand is 0.008 MCM for livestock use and 1.81 MCM for irrigation use, totaling 1.818 MCM. The direct construction cost is allocated as shown below.

Allocation of Direct Construction Cost

Item	Unit	Total demand	Domestic water	Livestock water	Irrigation water
Annual water demand	'000 m^3	1,818	0	8	1,810
Direct construction cost	Million Rp.	8,526	0	25	8,501

Thus, the value of livestock water is estimated to be Rp. 3,125/m^3 . As the unit net value of additionally increasing cattle weight is estimated to be Rp. 180,000/head, the total net value can be expected to be Rp. 76.1 million by supplying stable livestock water being worth Rp. 25.0 million to 423 equivalent heads of cow fed by beneficiary breeding households.

8.2 Economic Consideration

(1) Economic cost

The financial costs are to be converted into the economic costs by applying the economic conversion factor (ECF) established by DGWRD in 1985. The ECFs applied are: 0.71 for preparatory works and all civil works including Embung, irrigation facilities, domestic water supply system and road networks; 0.75 for unskilled on-farm labor and farm labor; 0.80 for land clearing, on-farm development and operation and maintenance cost; and tertiary irrigation system development, 0.90 for design and survey works and administration; and 1.00 for O&M equipment and replacement cost.

When the financial cost is converted to the economic cost, the contract tax, land acquisition cost and price contingency are fully excepted. In this Study, only the purchasing cost of consumables and goods appropriated in the administration cost is to be converted to the economic administration cost, as the normal payment to civil servants is principally appropriated in the operation budget of the Government. As the construction cost of dam and engineering cost estimated include some allowance to cover additional cost for expatriates, 50% of the engineering cost is to be converted to the economic cost in order to make the estimated cost equal to the level of local cost.

The economic cost converted and its annual disbursement schedule are shown in Table 8.1.

(2) Economic benefit

The irrigation benefits of the Project are principally derived from increased crop production attributable to stable irrigation water supply, full utilization of available farm land resources and optimum farm input supply. Table 8.2 gives financial and economic prices of farm inputs and outputs estimated for major islands. Based on the proposed quantity of farm inputs, anticipated crop yield and economic farm gate prices, the economic crop budget is estimated as shown in Table 8.3.

The annual net incremental benefit is thus estimated to be Rp. 203.7 million. This increment benefit will accure from the first year when irrigation water can be released from the Ntonggu II Embung. Taking the present agricultural situation and farmers capability into account, it is assumed that five years are needed as the build-up period to attain the anticipated crop yield level. In the proposed reservoir area, rainfed paddy field of 27 ha will be under the reservoir water after completion of the proposed Ntonggu II Embung, the total amount of production foregone is estimated to be around Rp. 14 million.

(3) Economic evaluation

The economic internal rate of return (EIRR) is examine as shown in Table 8.4 on costs and benefits as at August 1994. The result of economic analysis reveals that there is no economic merit in developing the proposed Ntonggu II Embung because the economic benefit attributed to the Embung development is too small compared with the required capital cost as the reservoir capacity of Embung is limited according to small runoff from the catchment area resulting in reduction of possible dry season irrigation area of 65 ha compared with the wet season irrigation area of 187 ha. Although the cattle feeding in Desa Ntonggu II can be stabilized by constant supply of livestock water to 423 equivalent heads of cow throughout the year, the investment efficiency is as low as 3.1 times when the value of additionally increasing cattle weight is compared with the value of livestock water.

(4) Farm budget analysis

With the implementation of the Ntonggu II Embung Project, the net on-farm income of farmers holding a unit farm size of 1.0 ha can be expected to increase by Rp. 3,972,200/year from Rp. 456,400/year under the "Without Project" condition with the cropping intensity of 105% to Rp. 4,428,600/year under the "With Project" condition with the cropping intensity of 200% as shown in Table 8.5 and below. Such improvement of farm budget would give much incentive for farmers to make further investment in improvement of their living standard and also could increase their payment capacity enabling beneficiary farmers to pay irrigation water charge to some extent.

Farm Budget for Unit Farm Size of 1 Ha

Crop	Watering Condition	Without Project		With Project	
		Crop Intensity (%)	Income (Rp.)	Crop Intensity (%)	Income (Rp.)
Paddy	Wet/Rainfed	34.8	144,333	-	-
	Wet/Irrigated	65.2	367,402	100.0	926,375
Soybean	Dry/Rainfed	5.3	26,650	-	-
Mungbean	Dry/Rainfed	-	-	65.2	548,769
	Dry/Irrigated	-	-	34.8	373,898
Total		105.3	538,385	200.0	1,849,042

8.3 Environmental Impact Assessment

Environmental impact assessment for the Project is carried out in consideration of the development objectives the Project.

(1) Environmental features of the Project area

The principal features of human and physical environment in the Ntonggu II Project area are summarized as below.

Environmental Features in the Ntonggu II Project Area

Item	Description
1. Human Environment	
Social intention	Insufficiency of reliable water sources and facilities for irrigation and livestock water use
Human use	Use of well water
Economic activities	Cultivation of irrigated paddy and Palawija, and livestock farming
Health and sanitation	Prevalence of waterborne intestinal diseases
2. Physical environment	
Geology/land	Volcanic rocks of Tertiary, limestone of Triassic to Permian
Surface/ground water	Surface water is not perennially observed
Endemic fauna and flora	None
3. Others	None

(2) Environmental Impact Assessment

Potential negative impact by Embung development in this Project area is only involuntary resettlement caused by land expropriation in the proposed reservoir area. The land of 27 ha in the reservoir area is utilized as cultivation, so that it is necessary that the land is expropriated. In Indonesia, land expropriation regarding development project is usually carried out by means of recommending an alternative land. In case of this Project, it is expected that the alternative land resources are ensured in the beneficiary area of the Project. Therefore, the land users can acquire more agricultural productivity than current status by means of a stable irrigation water supply. However, the land transfer shall force the land users/owners to resettle nearby their new farmland. It may result in resistance or apprehension against new customs and activities among the settled inhabitants, and further of discord between them and inhabitants who have lived there.

The mitigatory measure to alleviate this potential negative impact is to provide equivalent or better social basis as possible. In addition, meeting and hearing with regard to project implementation should be held with participation of the both inhabitants, so that it is possible to reduce such discords or other troubles as mentioned above.

(3) Primary information of environmental assessment

To support environmental analysis presentation for this Project implementation on the Indonesian rule, primary information on environmental assessment is compiled in the Attachment to the Volume 4.

8.4 Contribution to Women in Development

Since housewives in the Project area manage their family budgets, an increase of the farmer's income would encourage women in investing surplus in improvement and diversification of their income sources.

9. CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

On the basis of categorization of 157 candidate schemes for the Study, the Ntonggu II Embung scheme is selected representing a typical sample scheme of which potential beneficiary area has its irrigation water intake on the source river of the proposed Embung, good farming system, and inhabitants' demand for further use of irrigation and livestock water. The proposed Ntonggu II Embung site has physically irrigable land resources of 187 ha in net and the annual discharge of 3.0 MCM from its catchment area of 6.7 km^2. Breeding households with a total of 423 equivalent heads of cow projected for the year of 2008 need to solve livestock water shortage problem during the dry season.

The runoff condition at the proposed Embung site is the determining factor in the optimization of development scale. To store inflow into the proposed reservoir to the maximum level, the dam height of Ntonggu II Embung is thus set to be 17.0 m with the total and effective storage capacities of 1.27 and 1.16 MCM, respectively. Under such condition, it can be expected to practice irrigated cropping of the wet season paddy fully but irrigated cropping of the dry season Palawija crop with low irrigation water demand partly. It can be expected to grow rainfed Palawija crop depending on soil moisture available in the early dry season and also to meet increasing livestock water demand of 423 equivalent heads of cow in the beneficiary area.

The structural components are main dam, spillway and dam O&M road as well as irrigation water distribution system. The homogeneous embankment dam is constructed with the crest length of 260 m, embankment volume of 252,000 m^3 and side-channel typed spillway having design flood discharge of 106 m^3/sec and overflow weir width of 20 m. The required investment cost amounts to Rp. 11.2 billion of which direct construction cost is estimated to be 6.2 billion.

The results of feasibility study reveal that construction of the candidate Embung at the proposed site is technically unsound and economically impossible because of limited runoff from the catchment area of the proposed Embung. The increasing livestock water demand of 423 equivalent heads of cow in the Project area could be fully met by creating a new water source through construction of the proposed Ntonggu II Embung, but the investment efficiency is not so high. Therefore, such type of Embung is worthless implementing from the technical and economic viewpoints.

9.2 Recommendations

If further development of irrigation water source is required in the Ntonggu II area, it is recommended to rehabilitate the existing intake weirs on the Ntonggu river instead of the proposed Embung development from the viewpoint of investment cost saving.

The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Ntonggu II Embung Development Project

Tables

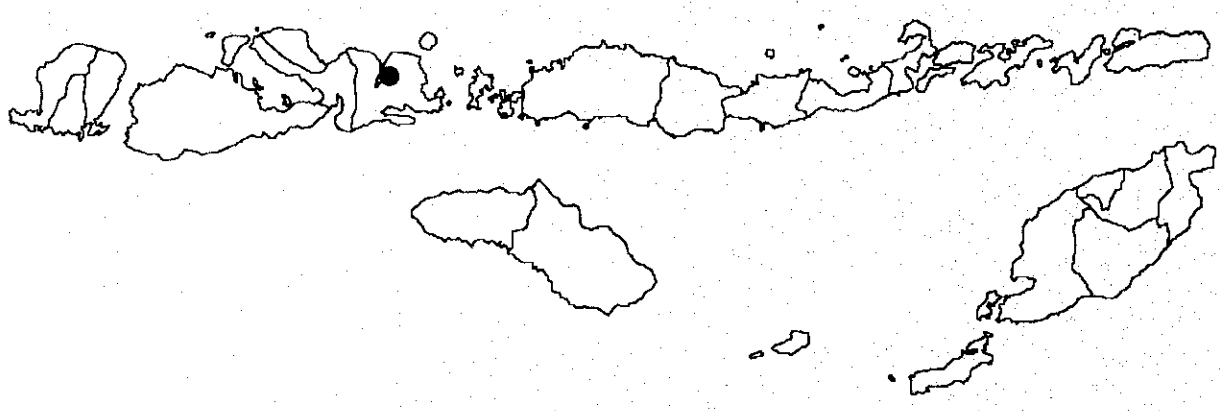


Table 1.1 Rainfall Record in Sila

Station : Sila
Kec./Kab. : Bolo/Bima
Elevation : + 20 m
Location : BT 118 37 55
LS 08 28 00

Year	Jan.		Feb.		Mar.		Apr.		Mei		Jun.		Jul.		Ags.		Sep.		Okt.		Nop.		Des.		Daily	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	Annual	Max.
1970	80	121	138	156	66	10	6	74	13	12	15	0	0	0	0	0	5	2	5	0	158	100	63	60	1,084	53
1971	86	214	93	93	55	214	12	23	14	14	5	7	7	0	0	0	0	0	0	32	92	108	137	132	1,338	110
1972	50	13	36	24	125	33	26	4	0	0	0	0	0	0	0	0	0	0	0	0	0	15	234	48	608	98
1973	99	82	120	89	90	72	40	22	50	64	0	6	6	0	0	0	2	8	0	6	140	75	48	95	1,114	68
1974	64	40	80	220	62	10	41	10	10	4	0	0	0	6	0	0	2	0	3	32	54	148	82	103	971	61
1975	69	49	64	17	41	134	143	43	42	15	0	0	0	0	0	0	18	3	17	138	26	78	135	55	1,087	107
1976	125	5	117	31	149	37	11	0	0	0	0	0	0	0	0	0	0	0	0	78	5	78	175	116	927	108
1977	135	218	93	179	94	84	55	0	12	0	0	0	0	0	0	0	0	0	0	0	0	26	122	112	1,130	84
1978	190	63	88	169	49	172	49	6	2	18	24	17	27	3	7	10	13	10	20	33	47	16	40	83	1,156	87
1979	98	130	21	108	101	2	0	0	53	31	16	0	0	0	0	0	0	0	0	0	0	0	0	0	560	41
1980	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	3	85	138	101	-	-
1981	107	51	224	68	89	48	13	0	40	11	46	0	0	0	0	0	25	23	8	0	89	95	79	32	1,048	57
1982	140	70	79	132	113	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	26	-	-
1983	208	0	43	36	66	35	66	13	10	2	1	0	0	0	0	0	0	0	17	80	27	237	8	41	890	64
1984	69	91	296	108	73	115	59	53	45	8	0	13	0	0	4	0	27	48	12	2	32	52	100	0	1,207	85
1985	0	247	57	179	248	9	1	41	0	13	19	0	0	0	0	0	0	0	0	9	1	106	135	14	1,079	107
1986	282	54	129	141	65	51	94	53	0	0	13	31	0	0	0	0	14	0	0	76	27	50	116	13	1,209	58
1987	138	150	109	116	3	34	4	44	0	0	9	4	3	0	0	3	0	0	0	0	12	104	435	154	1,322	97
1988	46	203	84	15	41	194	35	3	26	3	7	0	0	0	0	0	4	0	58	13	33	157	67	98	1,087	73
1989	63	76	60	124	28	84	12	15	13	23	26	55	2	24	0	0	0	0	0	42	31	39	178	17	912	60
1990	194	222	149	118	139	24	0	7	20	0	3	0	6	0	0	0	0	0	2	20	0	7	128	210	-	-
1991	272	153	116	96	6	5	152	48	0	0	0	0	21	4	0	0	0	0	0	0	26	84	27	28	1,038	60
1992	166	60	25	122	110	15	12	67	3	20	0	0	0	0	0	0	0	0	0	0	46	83	238	103	1,070	88
1993	0	67	55	32	82	67	28	11	7	4	0	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rata-rata	117	104	99	103	82	64	39	24	16	11	8	7	3	2	1	1	5	4	6	26	39	79	122	73	1,036	-

note. : x => data not available

Table 1.2 Climate in Godo

Station : Godo
Kec./Kab : Woha / Bima
Elevation : + 5 m
Location : BT. 118 38' 30"
LS. 08 32'00"

Description	Unit	Jan.	Feb.	Mar.	Apr.	Mei	Jun.	Jul	Ags.	Sep.	Okt.	Nop.	Des.	Annual Mean	Year
Mean Temperature	C	28.1	28.0	28.0	28.1	27.9	26.9	26.3	26.5	27.7	29.0	29.2	28.4	27.8	1976 - 1985
Mean Maximum Temperature	C	32.6	32.3	32.6	33.4	33.1	32.1	28.2	32.7	34.0	35.6	35.4	33.7	33.0	1976 - 1985
Mean Minimum Temperature	C	23.8	23.6	23.5	22.8	22.4	21.5	20.8	20.4	21.1	22.1	23.6	23.3	22.4	1976 - 1985
Mean Relative Humidity	%	88.0	89.0	88.0	86.0	86.0	85.0	84.0	81.0	80.0	82.0	83.0	86.0	84.8	1976 - 1985
Mean Maximum Relative Humidity	%	94.0	94.0	95.0	95.0	93.0	91.0	90.0	89.0	88.0	87.0	89.0	92.0	91.4	1976 - 1985
Mean Minimum Relative Humidity	%	78.0	80.0	78.0	73.0	72.0	73.0	73.0	68.0	66.0	67.0	71.0	74.0	72.8	1976 - 1985
Mean Dew Point	C	25.2	24.8	25.1	24.8	24.4	23.5	22.9	22.5	23.4	24.8	25.5	25.2	24.3	1976 - 1985
Mean Sunshine Hours	%	33.0	36.0	47.0	60.0	62.0	60.0	65.0	70.0	69.0	66.0	53.0	40.0	55.1	1976 - 1985
Mean Solar Radiation	Cal/Cm2	294.0	295.0	316.0	312.0	288.0	281.0	291.0	309.0	351.0	345.0	338.0	310.0	310.8	1976 - 1982
Mean Wind Velocity	Km/hr	3.7	3.2	3.0	3.1	4.5	5.9	6.9	6.4	6.7	6.4	5.0	3.3	4.8	1976 - 1985
Mean Evaporation	mm/day	5.3	4.8	5.5	6.3	6.8	6.8	7.4	8.2	8.9	9.8	8.6	6.1	7.0	1976 - 1985
Mean Monthly Rainfall	mm	187.0	171.0	137.0	60.0	51.0	16.0	17.0	8.0	12.0	19.0	119.0	188.0	985.0	1977 - 1985

Table 1.3 Typical Soil Profile in the Ntonggu II Project Area

Profile No.:	2
Soil Classification:	Ustic Endoaquerts
Physiography:	Alluvial fan
Topography:	Almost flat (0 - 4 %)
Land Use/Vegetation:	Irrigated paddy field
Parent material:	Alluvium material
Drainage:	Well
Groundwater Table:	5 - 10 m
Permeability:	Slow (0.41 cm/hr)
Land Morphology:	Cracking 3 cm width, 35 cm depth

Horizon	Depth (cm)	Description
Ap	0 - 20	Gray-light brownish gray (2.5Y 6/1, dry); clay loam; strong, angular blocky, coarse structure; sticky, plastic, very firm, very hard consistency; abrupt, smooth horizon boundary
Bw1	20 - 63	Black (2.5YR2/1, dry); clay loam; strong, angular blocky, cparse structure; sticky, plastic, very firm, very hard structure; abrupt, smooth horizon boundary
Bw2	63 - 110+	Very dark grayish brown (2.5YR 3/2, dry); clay; light olive brown (2.5Y 5/4), few, fine, prominant mottling; sticky, plastic, very firm, very hard consistency

Source: Soil survey carried out by the local consultant under supervision of the JICA Study Team

Table 1.4 Results of Soil Laboratory Test in the Ntonggu II Project Area

Soil Pit	Layer	Texture			Permeability	pH	pH	Organic	Total N	Ava. P	CEC	Ex. Na	Ex. Ca	Ex. K	Ex. Mg	Base	EC
		Sand (%)	Silt (%)	Clay (%)	(cm/hr)	(H2O)	(KCl)	matter	(%)	(ppm)	(me/100g)	(me/100g)	(me/100g)	(me/100g)	(me/100g)	Saturation (%)	(mS/cm)
2	Ap	51.4	17.3	31.3	0.4	7.4	5.7	1.18	0.06	3.49	17.62	0.44	6.19	0.55	2.53	55	0.14
	Bw1	29.6	35.0	35.5	2.0	7.4	5.7	1.05	0.04	3.75	19.65	0.48	5.46	0.58	2.25	45	0.08
	Bw2	36.1	19.3	44.6		7.6	6.4	0.63	0.04	1.73	22.42	0.51	6.54	0.58	2.54	45	0.12
5	1A	50.4	13.3	36.3	0.3	7.2	5.6	1.33	0.07	2.18	20.81	0.39	9.60	0.20	1.85	58	0.12
	2A	77.6	15.4	7.0	1.3	7.3	5.6	0.59	0.03	2.01	15.68	0.24	7.81	0.23	1.36	61	0.06
	3A	89.2	5.5	5.3		7.2	5.7	0.35	0.03	1.83	17.60	0.19	7.32	1.64	1.23	59	0.06
12	Ap	36.6	31.3	32.1	5.7	7.6	6.3	1.17	0.04	2.96	16.05	0.88	8.08	0.42	1.20	66	0.28
	2A	70.2	25.3	4.5	9.1	7.7	6.4	0.57	0.02	3.30	18.67	0.70	9.45	0.44	1.24	63	0.24
	3A	46.6	32.4	21.0		7.4	6.5	0.94	0.02	3.64	21.85	0.68	8.70	0.68	1.95	55	0.18

Source: Soil survey carried out by the local contractor under supervision of the JICA Team

Table 1.5 Soil Classification in the Ntonggu II Project Area

Land Unit	Description	Physiography	Topography	Potential Suitability			Area	
				Paddy	Soybean	Maize	(ha)	(%)
I	Typic Haplusterts deep; very fine clay-coarse loamy; neutral; moderate CEC; slow-very slow permeability	Alluvial fan-mountain foot slope	Flat-undulating (1-6%)	S1/S2	S1	S1/S2	61	10%
II	Ustic Endoaquerts deep; fine loam-coarse loamy; neutral; moderate CEC; slow-moderate permeability; moderately well-well drainage	Alluvial fan	Flat (0-4%)	S1	S1	S1	95	16%
III	Oxyaquic Ustifluvents deep; fine loam-coarse loamy; neutral; moderate CEC; moderate-rapid permeability; well drainage	Alluvial fan	Flat (0-2%)	S1	S1	S1	125	21%
IV	Oxyaquic Ustipsamments deep; coarse loamy; neutral; moderate CEC; slightly rapid permeability; well drainage	Middle alluvial fan	Flat (0-1%)	S2	S1	S2	37	6%
V	Mollic Ustifluvents deep; fine loamy; neutral; moderate CEC; slightly slow permeability; well drainage	Middle alluvial fan	Flat (0-1%)	S1	S1	S1	25	4%
VI	Oxyaquic Ustropepts very deep; very fine clay; neutral; moderate CEC; moderate permeability; well drainage	Middle alluvial fan	Flat (0-1%)	S2	S1	S2	18	3%
VII	Tropic Fluvaquents deep; fine loamy; low CEC; moderate permeability; poor drainage	Alluvial fan	Flat (0-1%)	S1	S1	S1	19	3%
#	Unclassified						203	35%
	Total						583	100%

Source: Soil survey carried out by the local consultant under supervision of the JICA Team

Table 1.6 Summary of Farm Household Economic Survey in the Ntonggu II Project Area

	Item	Unit	Respond't No. 1	Respond't No. 2	Respond't No. 3	Respond't No. 4	Respond't No. 5	Respond't No. 6	Respond't No. 7	Respond't No. 8	Respond't No. 9	Respond't No. 10	Respond't No. 11	Respond't No. 12	Respond't No. 13	Respond't No. 14	Respond't No. 15	Average
1	Sex and Age		Male 42	Male 36	Male 42	Male 45	Male 35	Male 40	Male 39	Male 40	Male 37	Male 50	Male 32	Male 34	Male 38	Male 43	Male 38	Male 39
2	No. of Family Member		M-1/F-2	M-2/F-4	M-1/F-2	M-1/F-2	M-2/F-3	M-1/F-4	M-1/F-4	M-3/F-2	M-3/F-2	M-3/F-2	M-1/F-1	M-3/F-2	M-2/F-2	M-2/F-3	M-2/F-1	M-2/F-2
3	Type of Side Job		Craftman	Entrepre.	Craftman	Civil Sv.	None	HC Driver	Civil Sv.	None	Middlemen	Seller	Trainner	Seller	Seller	Labourer	Civil Sv.	
4	Own Farmland	ha	0.77	0.00	0.75	2.20	3.04	3.14	1.00	1.53	1.55	0.74	0.69	0.53	1.35	0.64	2.04	1.33
	Rented Farmland	ha	0.20	1.50	0.20	0.00	2.00	3.10	0.00	0.30	0.00	0.00	0.00	0.30	0.94	0.00	0.00	0.57
	Yield Division	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(Paddy field)	ha	0.45	0.50	0.45	1.16	4.00	1.00	1.00	0.80	1.50	0.50	0.30	0.80	1.00	0.30	1.00	0.98
5	Cropped Area	ha	1.40	2.00	1.40	2.91	9.00	4.00	2.00	2.30	5.00	1.20	0.95	1.60	3.20	0.90	3.00	2.72
	(Paddy)	ha	0.45	0.50	0.45	1.16	4.00	1.00	1.00	0.80	4.00	0.50	0.30	0.80	1.00	0.30	1.00	1.15
	(Palawija)	ha	0.95	1.50	0.95	1.75	5.00	3.00	1.00	1.50	1.00	0.70	0.65	0.80	2.20	0.60	2.00	1.57
	(Others)	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Cow/Buffalo	head	2	2	2	0	0	4	3	3	0	0	0	0	7	0	6	2
	Horse	head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Goat/Sheep	head	0	0	0	2	0	1	0	0	0	14	0	2	0	0	4	2
	Pig	head	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	Chicken/Duck	head	5	20	5	7	3	20	0	10	0	11	28	10	9	7	0	9
7	Gross Income	Rp.'000/yr	1,997.5	3,487.5	1,572.0	3,260.0	7,000.0	4,449.0	2,960.0	1,860.0	3,975.0	3,035.0	1,963.5	3,290.0	5,473.0	2,085.0	6,145.0	3,503.5
	(Crop)	Rp.'000/yr	1,457.5	2,947.5	1,140.0	2,360.0	7,000.0	2,984.0	1,220.0	1,660.0	3,075.0	1,110.0	451.5	1,810.0	3,473.0	885.0	2,875.0	2,296.6
	(Livestock)	Rp.'000/yr	0.0	0.0		0.0	0.0	25.0	0.0	200.0	0.0	125.0	0.0	40.0	200.0	0.0	150.0	49.3
	(Side job)	Rp.'000/yr	540.0	540.0	432.0	900.0	0.0	1,440.0	1,740.0	0.0	900.0	1,800.0	1,512.0	1,440.0	1,800.0	1,200.0	3,120.0	1,157.6
	(Miscellaneous)	Rp.'000/yr	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	Expenditure	Rp.'000/yr	2,083.3	2,956.9	2,408.5	2,757.8	4,519.2	2,893.5	3,366.0	2,084.0	3,069.5	3,542.8	3,094.1	2,426.0	3,008.8	1,502.9	3,102.3	2,854.4
	(Food/drink)	Rp.'000/yr	1,112.4	1,436.4	1,296.0	1,152.0	1,399.2	1,321.2	1,561.2	1,224.0	1,224.0	1,638.0	1,737.6	1,324.8	1,332.0	960.0	1,356.0	1,338.3
	(Living)	Rp.'000/yr	387.4	743.0	462.0	528.0	574.0	406.0	477.0	315.0	698.0	613.0	1,005.0	471.4	532.0	270.2	537.0	534.6
	(Education)	Rp.'000/yr	250.0	251.0	175.0	205.0	241.0	266.0	585.0	38.0	300.0	800.0	0.0	207.5	456.0	20.5	381.0	278.4
	(Production)	Rp.'000/yr	333.5	526.5	475.5	872.8	2,305.0	900.3	742.8	507.0	847.5	491.8	351.5	422.3	688.8	252.2	828.3	703.1
9	Surplus/Deficit	Rp.'000/yr	-85.8	530.6	-836.5	502.2	2,480.8	1,555.6	-406.0	-224.0	905.5	-507.8	-1,130.6	864.0	2,464.2	582.1	3,042.7	649.1
10	Saving	Rp.'000/yr	0.0	40.0	0.0	180.0	180.0	120.0	120.0	0.0	0.0	60.0	0.0	0.0	120.0	0.0	180.0	66.7

Source : JICA Agro-economy Survey

Table 2.1 Estimated Evapotranspiration in Ntonggu II Project

Site : Ntonggu II
Meteorological Station : Godo

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
T mean	C	28.10	28.00	28.00	28.10	27.90	26.90	26.30	26.50	27.70	29.00	29.20	28.40
RH mean	%	88.00	89.00	88.00	86.00	86.00	85.00	84.00	81.00	80.00	82.00	83.00	86.00
U km/day	km/day	88.80	76.80	72.00	74.40	108.00	141.60	165.60	153.60	160.80	153.60	120.00	79.20
ea	mbar	37.80	37.59	37.59	37.80	37.38	35.28	34.02	34.44	36.96	39.87	40.33	38.49
RH/100		0.88	0.89	0.88	0.86	0.86	0.85	0.84	0.81	0.80	0.82	0.83	0.86
ed	mbar	33.26	33.46	33.08	32.51	32.15	29.99	28.58	27.90	29.57	32.69	33.47	33.10
(ea-ed)	mbar	4.54	4.13	4.51	5.29	5.23	5.29	5.44	6.54	7.39	7.18	6.86	5.39
f(u)		0.51	0.48	0.46	0.47	0.56	0.65	0.72	0.68	0.70	0.68	0.59	0.48
(1-W)		0.23	0.23	0.23	0.23	0.23	0.24	0.25	0.25	0.23	0.23	0.22	0.23
(1-W)f(u)(ea-ed)	mm/day	0.53	0.46	0.48	0.57	0.68	0.84	0.97	1.10	1.22	1.11	0.91	0.60
Ra	mm/day	16.40	16.30	15.50	14.20	12.80	12.00	12.40	13.50	14.80	15.90	16.20	16.20
n	hr/day	2.64	2.88	3.76	4.80	4.96	4.80	5.20	5.60	5.52	5.28	4.24	3.20
N	hr/day	12.60	12.40	12.10	11.80	11.60	11.50	11.60	11.80	12.00	12.30	12.60	12.70
(0.25+0.50n/N)		0.35	0.37	0.41	0.45	0.46	0.46	0.47	0.49	0.48	0.46	0.42	0.38
Rs	mm/day	5.82	5.97	6.28	6.44	5.94	5.50	5.88	6.58	7.10	7.39	6.78	6.09
Rns	mm/day	4.65	4.77	5.03	5.15	4.75	4.40	4.70	5.26	5.68	5.91	5.42	4.87
f(T)		16.30	16.30	16.30	16.30	16.26	16.06	15.94	15.98	16.22	16.50	16.54	16.38
f(ed)		0.08	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.08	0.08	0.08
f(n/N)		0.29	0.31	0.38	0.47	0.48	0.48	0.50	0.53	0.51	0.49	0.40	0.33
Rnl=f(T)f(ed)f(n/N)	mm/day	0.38	0.41	0.51	0.64	0.68	0.72	0.81	0.87	0.80	0.67	0.54	0.44
Rn =Rns-Rnl		4.27	4.37	4.52	4.51	4.07	3.68	3.90	4.39	4.88	5.24	4.88	4.43
W		0.77	0.77	0.77	0.77	0.77	0.76	0.75	0.75	0.77	0.77	0.78	0.77
W Rn		3.29	3.36	3.47	3.47	3.13	2.79	2.93	3.31	3.74	4.06	3.79	3.42
c		1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Eto	mm/day	4.20	4.20	4.35	4.45	4.19	3.99	4.29	4.86	5.45	5.68	5.17	4.42

Source : JICA Study Team estimation by Modified Penman Method based on the meteorological data at the Godo staiton.

Table 2.2 Effective Rainfall in Ntonggu II Project

Site : Ntonggu II
Meteorological Station : Sila

Month	Evapotrans-piration (ETo)	Average Rainfall		Annual-base Dependable Rainfall	Effective Rainfall	
					Paddy	Palawija
	[1] (mm)	[2] (mm)	[3] (%)	[4] (mm)	[5] (mm)	[6] (mm)
January	130	221	21.4%	188	132	121
February	117	202	19.5%	172	120	108
March	135	146	14.1%	124	87	85
April	133	63	6.1%	54	38	40
May	130	27	2.6%	23	16	18
June	120	15	1.4%	13	9	10
July	133	5	0.5%	4	3	0
August	151	2	0.2%	2	1	0
September	164	9	0.9%	8	5	0
October	176	32	3.1%	27	19	23
November	155	118	11.4%	100	70	75
December	137	195	18.8%	166	116	111
Total	1,681	1,035	100.0%	881	617	591

Note ;

[1] : Estimated by Modified Penman Method based on Godo station
[2] : Rainfall data in station compiled by P3SA (1970-1992)
[3] : Percentage of monthly rainfall to annual rainfall, calculated from column [2]
[4] : 881 mm (Calculated 80 % dependable annual rainfall) x [3]
[5] : [4] x 0.70
[6] : Derived by USDA SCS Method introduced by Design Criteria KP-01, where effective storage is assumed 75 mm

Source ; JICA Study Team estiamtin based on the rainfall data at the Sila statin

Table 2.3 Irrigation Water Requirement in Ntonggu II Project (1/4)

Site : Ntonggu-II
Crops : Wet Season Paddy

Item		Month (days)	Jan. 1 15	Jan. 2 16	Feb. 1 14	Feb. 2 14	Mar. 1 15	Mar. 2 16	Apr. 1 15	Apr. 2 15	May 1 15	May 2 16	Jun. 1 15	Jun. 2 15	Jul 1 15	Jul 2 16	Aug. 1 15	Aug. 2 16	Sep. 1 15	Sep. 2 15	Oct. 1 15	Oct. 2 16	Nov. 1 15	Nov. 2 15	Dec. 1 15	Dec. 2 16	Annual
I. Evapotranspiration (Eto)		mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
		mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1.681
II. Wet Season Paddy																											
(1) Proposed cropping pattern / Crop coefficient																											
- WP-1			1.10	1.10	1.05	1.05	0.95	0.00																	LP	LP	
- WP-2			LP	1.10	1.10	1.05	1.05	0.95	0.00																	LP	
- WP-3			LP	LP	1.10	1.10	1.05	1.05	0.95	0.00																	
(2) Crop consumptive use (Etc)																											
- WP-1		mm	69	74	62	62	62	0																			329
- WP-2		mm		74	65	62	69	66	0																		335
- WP-3		mm			65	65	69	73	63	0																	334
(3) Land preparation (IR)																											
- WP-1		mm																							183	195	378
- WP-2		mm	182																							195	377
- WP-3		mm	182	194																							376
(4) Percolation																											
- WP-1		mm	30	32	28	28	30																				
- WP-2		mm		32	28	28	30	32																			
- WP-3		mm			28	28	30	32	30																		
(5) Water layer replacement (RW)																											
- WP-1		mm		50		50																					
- WP-2		mm			50		50																				
- WP-3		mm				50		50																			
(6) Effective rainfall (ER)		mm	64	68	60	60	42	45	19	19	8	8	5	4	1	2	0	1	2	3	9	10	35	35	56	60	616
(7) Field water requirement																											
- WP-1		mm	35	88	30	80	50	0																	127	135	545
- WP-2		mm	118	38	83	30	107	53	0																	135	563
- WP-3		mm	118	126	33	83	57	110	74	0																	600
(8) Diversion requirement		mm	139	129	74	99	109	84	38	0															65	138	876
		m3/ha	1,390	1,290	740	990	1,090	840	380	0															650	1,380	8,750

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 2.3 Irrigation Water Requirement in Ntonggu II Project (2/4)

Site : Ntonggu-II
Crops : Dry Season Paddy

Item		Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2	May 1	May 2	Jun. 1	Jun. 2	Jul 1	Jul 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Annual
	Month (days)	15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)	mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
	mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Dry Season Paddy																										
(1) Proposed cropping pattern / Crop coefficient																										
- DP-1								LP	LP	LP	1.10	1.10	1.05	1.05	0.95	0.00										
- DP-2										LP	LP	1.10	1.10	1.05	1.05	0.95	0.00									
- DP-3											LP	LP	1.10	1.10	1.05	1.05	0.95	0.00								
(2) Crop consumptive use (Etc)																										
- DP-1	mm										74	66	63	68	65	0										335
- DP-2	mm											66	66	68	72	69	0									341
- DP-3	mm												66	71	72	77	74	0								359
(3) Land preparation (IR)																										
- DP-1	mm								183	182																365
- DP-2	mm									182	194															376
- DP-3	mm										194	179														373
(4) Percolation																										
- DP-1	mm										32	30	30	30	32	0										
- DP-2	mm											30	30	30	32	30	0									
- DP-3	mm												30	30	32	30	32	0								
(5) Water layer replacement (RW)																										
- DP-1	mm											50		50												
- DP-2	mm												50		50											
- DP-3	mm													50		50										
(6) Effective rainfall (ER)	mm	64	68	60	60	42	45	19	19	8	8	5	4	1	2	0	1	2	3	9	10	35	35	56	60	616
(7) Field water requirement																										
- DP-1	mm								164	174	98	141	89	147	145	0										957
- DP-2	mm									174	186	91	142	97	152	99	0									941
- DP-3	mm										186	174	92	150	102	157	105	0								965
(8) Diversion requirement	mm								84	178	241	208	165	201	205	131	54	0								1,468
	m3/ha								840	1,780	2,410	2,080	1,650	2,010	2,050	1,310	540	0								14,670

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 2.3 Irrigation Water Requirement in Ntonggu II Project (3/4)

Site : Ntonggu-II
Crops : Palawija (1/2) : Mungbeans and Red onion

Item		Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2	May 1	May 2	Jun. 1	Jun. 2	Jul 1	Jul 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Annual
		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)	mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
	mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Palawija(1), (2) : Mungbans and Red onion																										
(1) Proposed cropping pattern / Crop coefficient(Kc)								**Mungbeans**										**Red onion**								
- Pwj(1),(2)-1								0.45		0.75	1.05	0.30						0.50		0.60	0.95	0.75				
- Pwj(1),(2)-2										0.45	0.75	1.05	0.30							0.50	0.60	0.95	0.75			
- Pwj(1),(2)-3											0.45	0.75	1.05	0.30							0.50	0.60	0.95	0.75		
(2) Crop consumptive use(Etc)																										
- Pwj(1),(2)-1	mm								30	47	70	18							41	51	86	58				
- Pwj(1),(2)-2	mm									28	50	63	18							43	55	74	58			
- Pwj(1),(2)-3	mm										30	45	63	19							45	47	74	50		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(1),(2)-1	mm								10	38	61	13							41	40	74	21				299
- Pwj(1),(2)-2	mm									19	41	58	13							32	43	37	20			262
- Pwj(1),(2)-3	mm										21	40	58	19							33	10	36	0		217
(5) Diversion requirement	mm								7	38	83	74	47	13					27	48	100	45	37	0		519
	m3/ha								70	380	830	740	470	130					270	480	1,000	450	370	0		5,190
III. Palawija (3) : Mungbeans																										
(1) Proposed cropping pattern / Crop coefficient(Kc)																		**Mungbeans**								
- Pwj(3)-1																		0.45		0.75	1.05	0.30				
- Pwj(3)-2																				0.45	0.75	1.05	0.30			
- Pwj(3)-3																					0.45	0.75	1.05	0.30		
(2) Crop consumptive use(Etc)																										
- Pwj(3)-1	mm																		37	64	95	23				
- Pwj(3)-2	mm																			38	68	81	23			
- Pwj(3)-3	mm																				41	58	81	20		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(3)-1	mm																		37	53	83	0				173
- Pwj(3)-2	mm																			27	56	44	0			128
- Pwj(3)-3	mm																				29	21	43	0		93
(5) Diversion requirement	mm																		25	53	112	44	29	0		263
	m3/ha																		250	530	1,120	440	290	0		2,630

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 2.3 Irrigation Water Requirement in Ntonggu II Project (4/4)

Site : Ntonggu-II
Crops : Palawija (2/2) : Tomato and Cabbage

Item		Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2	May 1	May 2	Jun. 1	Jun. 2	Jul 1	Jul 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Annual
	Month (days)	15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	
I. Evapotranspiration (Eto)	mm/day	4.20	4.20	4.20	4.20	4.35	4.35	4.45	4.45	4.19	4.19	3.99	3.99	4.29	4.29	4.86	4.86	5.45	5.45	5.68	5.68	5.17	5.17	4.42	4.42	
	mm	63	67	59	59	65	70	67	67	63	67	60	60	64	69	73	78	82	82	85	91	78	78	66	71	1,681
II. Palawija(4) : Tomato																										
(1) Proposed cropping pattern / Crop coefficient(Kc)																**Tomato**										
- Pwj(4)-1																	0.45	0.75	1.05	1.05	0.80	0.60				
- Pwj(4)-2																		0.45	0.75	1.05	1.05	0.80	0.60			
- Pwj(4)-3																			0.45	0.75	1.05	1.05	0.80	0.60		
(2) Crop consumptive use(Etc)																										
- Pwj(4)-1	mm																35	61	86	89	73	47				
- Pwj(4)-2	mm																	37	61	89	95	62	47			
- Pwj(4)-3	mm																		37	64	95	81	62	40		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(4)-1	mm																35	61	86	78	61	10				331
- Pwj(4)-2	mm																	37	61	78	83	25	9			294
- Pwj(4)-3	mm																		37	53	83	44	24	0		242
(5) Diversion requirement	mm																23	65	123	140	152	53	22	0		577
	m3/ha																230	650	1,230	1,400	1,520	530	220	0		5,780
III. Palawija (5) : Cabbage																										
(1) Proposed cropping pattern / Crop coefficient(Kc)																	**Cabbage**									
- Pwj(5)-1																		0.45	0.70	0.95	0.90	0.80				
- Pwj(5)-2																			0.45	0.70	0.95	0.90	0.80			
- Pwj(5)-3																				0.45	0.70	0.95	0.90	0.80		
(2) Crop consumptive use(Etc)																										
- Pwj(5)-1	mm																	37	57	81	82	62				
- Pwj(5)-2	mm																		37	60	86	70	62			
- Pwj(5)-3	mm																			38	64	74	70	53		
(3) Effective rainfall (ER)	mm	59	62	54	54	41	44	20	20	9	9	5	5	0	0	0	0	0	0	11	12	37	38	54	57	591
(4) Field water requirement																										
- Pwj(5)-1	mm																	37	57	70	70	25				259
- Pwj(5)-2	mm																		37	49	74	33	24			217
- Pwj(5)-3	mm																			27	52	37	32	0		147
(5) Diversion requirement	mm																	25	63	97	130	63	37	0		415
	m3/ha																	250	630	970	1,300	630	370	0		4,150

Source : JICA Study Team estimate based on the meteorological data at the Godo and the Sila station

Table 3.1 Estimated Catchment Rainfall in Ntonggu II Embung Site

Unit : mm

year	Jan		Feb		Mar.		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1970	104	157	179	203	86	13	8	96	17	16	20	0	0	0	0	0	7	3	7	0	205	130	82	78	1,411
1971	112	278	121	121	72	278	16	30	18	18	7	9	9	0	0	0	0	0	0	42	120	140	178	172	1,741
1972	65	17	47	31	163	43	34	5	0	0	0	0	0	0	0	0	0	0	0	0	0	20	304	62	791
1973	129	107	156	116	117	94	52	29	65	83	0	8	8	0	0	0	3	10	0	8	182	98	62	124	1,451
1974	83	52	104	286	81	13	53	13	13	5	0	0	0	8	0	0	3	0	4	42	70	192	107	134	1,263
1975	90	64	83	22	53	174	186	56	55	20	0	0	0	0	0	0	23	4	22	179	34	101	176	72	1,414
1976	163	7	152	40	194	48	14	0	0	0	0	0	0	0	0	0	0	0	0	101	7	101	228	151	1,206
1977	176	283	121	233	122	109	72	0	16	0	0	0	0	0	0	0	0	0	0	0	0	34	159	146	1,471
1978	247	82	114	220	64	224	64	8	3	23	31	22	35	4	9	13	17	13	26	43	61	21	52	108	1,504
1979	127	169	27	140	131	3	0	0	69	40	21	0	0	0	0	0	0	0	0	0	0	0	0	0	727
1980	51	91	34	56	7	31	20	0	0	14	0	0	0	0	0	0	0	0	0	0	4	111	179	131	729
1981	139	66	291	88	116	62	17	0	52	14	60	0	0	0	0	0	33	30	10	0	116	124	103	42	1,363
1982	182	91	103	172	147	43	55	0	0	0	0	0	0	0	7	0	0	0	0	0	0	7	14	34	855
1983	270	0	56	47	86	46	86	17	13	3	1	0	0	0	0	0	0	0	22	104	35	308	10	53	1,157
1984	90	118	385	140	95	150	77	69	59	10	0	17	0	0	5	0	35	62	16	3	42	68	130	0	1,571
1985	0	321	74	233	322	12	1	53	0	17	25	0	0	0	0	0	0	0	0	12	1	138	176	18	1,403
1986	367	70	168	183	85	66	122	69	0	0	17	40	0	0	0	0	18	0	0	99	35	65	151	17	1,572
1987	179	195	142	151	4	44	5	57	0	0	12	5	4	0	0	4	0	0	0	0	16	135	566	200	1,719
1988	60	264	109	20	53	252	46	4	34	4	9	0	0	0	0	0	5	0	75	17	43	204	87	127	1,413
1989	82	99	78	161	36	109	16	20	17	30	34	72	3	31	0	0	0	0	0	55	40	51	231	22	1,187
1990	252	289	194	153	181	31	0	9	26	0	4	0	8	0	0	0	0	0	3	26	0	9	166	273	1,624
Mean	141	134	130	134	105	88	45	25	22	14	11	8	3	2	1	1	7	6	9	35	48	98	151	94	1,313

Table 3.2 Estimated Discharge at Ntonggu II Embung Site

Unit : 1000 m3

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
year	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1970	244	368	420	476	202	0	0	225	0	0	0	0	0	0	0	0	0	0	0	0	481	305	192	183	3,096
1971	263	652	284	284	169	652	0	70	0	0	0	0	0	0	0	0	0	0	0	98	281	328	417	403	3,901
1972	152	0	110	73	382	101	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	713	145	1,756
1973	303	251	366	272	274	220	122	68	152	195	0	0	0	0	0	0	0	0	0	0	427	230	145	291	3,316
1974	195	122	244	671	190	0	124	0	0	0	0	0	0	0	0	0	0	0	0	98	164	450	251	314	2,823
1975	211	150	195	52	124	408	436	131	129	0	0	0	0	0	0	0	54	0	52	420	80	237	413	169	3,261
1976	382	0	356	94	455	113	0	0	0	0	0	0	0	0	0	0	0	0	0	237	0	237	535	354	2,763
1977	413	664	284	546	286	256	169	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	373	342	3,413
1978	579	192	267	516	150	525	150	0	0	54	73	52	82	0	0	0	0	0	61	101	143	49	122	253	3,369
1979	298	396	63	328	307	0	0	0	162	94	49	0	0	0	0	0	0	0	0	0	0	0	0	0	1,697
1980	120	213	80	131	0	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	260	420	307	1,604
1981	326	155	682	206	272	145	0	0	122	0	141	0	0	0	0	0	77	70	0	0	272	291	242	98	3,099
1982	427	213	242	403	345	101	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	1,940
1983	633	0	131	110	202	108	202	0	0	0	0	0	0	0	0	0	0	0	52	244	82	722	0	124	2,610
1984	211	277	903	328	223	352	181	162	138	0	0	0	0	0	0	0	82	145	0	0	98	159	305	0	3,564
1985	0	753	174	546	755	0	0	124	0	0	59	0	0	0	0	0	0	0	0	0	0	324	413	0	3,148
1986	861	164	394	429	199	155	286	162	0	0	0	94	0	0	0	0	0	0	0	232	82	152	354	0	3,564
1987	420	457	333	354	0	103	0	134	0	0	0	0	0	0	0	0	0	0	0	0	0	317	1,327	469	3,914
1988	141	619	256	0	124	591	108	0	80	0	0	0	0	0	0	0	0	0	176	0	101	478	204	298	3,176
1989	192	232	183	378	84	256	0	0	0	70	80	169	0	73	0	0	0	0	0	129	94	120	542	52	2,654
1990	591	678	455	359	424	73	0	0	61	0	0	0	0	0	0	0	0	0	0	61	0	0	389	640	3,731
Mean	332	312	306	312	246	202	95	51	40	20	19	15	4	3	0	0	10	10	16	77	110	226	350	215	2,971
	644		618		448		146		60		34		7		0		20		93		335		566		

Table 3.3 Probable Flood Discharge at Ntonggu II Embung Site

Characteristics of the catchment area								
Catchment Area	(km2)	6.70						
Eelevation at Dam Site (1)	(m)	70						
Maximum elevation in the catchment area (2)	(m)	700						
Height (3)=(2)-(1)	(h)	630						
Length of Catchment Area (L)	(m)	4,000						
Flow velocity	W2 (km/hr)	23.75						
Time of concentration	T2 (hrs)	0.17						
Probable Flood Discherge								
Return Period	(years)	2	5	10	20	50	100	200
Rainfall	(mm/day)	79	98	109	120	133	143	152
Rainfall intensity within the time of concentration	(mm)	39	49	54	60	66	71	76
Probable Flood Discharge	(m3/s)	59	73	81	89	99	106	113
Specific Discharge	(m3/s/km2)	9	11	12	13	15	16	17

To estimate design rainfall, the Log Pearson III method is adopted.
The rational method is adopted for estimation of the design flood discharge.
C = 0.8 is used to estimate designed flood discharge by the rational method.

Table 3.4 Result of Water Quality Test in Ntonggu II Embung Site

DESCRIPTION	UNIT	1 Upstream of proposed embung	2 Embung Site	3 Embung Site	4 downstream of proposed embung	Max. Limit of B Class by GR. NO. 20/1990
I. PHYSICS						
1 Temperature	C	28.00	28.00	28.00	30.00	Normal water temperature
2 Dissolved solid matter	mg/liter	481.00	484.00	473.00	649.00	1000
3 Electric Conductivety	umhos/cm	654.00	657.00	644.00	883.00	-
II. CHEMISTRY						
a. Unorganic chemistry						
1 Mercury	mg/liter	0.00	0.00	0.00	0.00	0.001
2 Ammonia	mg/liter	0.00	0.00	0.00	0.00	0.5
3 Arcenic	mg/liter	-	-	-	-	0.05
4 Barium	mg/liter	-	-	-	-	5
5 Ferro	mg/liter	0.00	0.00	0.00	0.00	1
6 Fluoride	mg/liter	0.50	0.55	0.18	0.08	1.5
7 Cadmium	mg/liter	0.00	0.00	0.00	0.00	0.005
8 Chloride	mg/liter	41.80	44.70	28.40	40.50	600
9 Chronium, valense-6	mg/liter	0.00	0.00	0.00	0.00	0.05
10 Manganese	mg/liter	0.00	0.28	0.00	0.00	0.5
11 Nitrate, N	mg/liter	0.00	0.00	0.61	0.90	10
12 Nitric, N	mg/liter	0.00	0.00	0.00	0.00	1
13 Dissolved Oxygen	mg/liter	7.89	8.07	6.42	4.03	*
14 pH	-	7.30	7.20	6.80	6.70	5-9
15 Selenium	mg/liter	-	-	-	-	0.01
16 Zinc	mg/liter	0.00	0.00	0.00	0.00	5
17 Cyanide	mg/liter	0.00	0.00	0.00	0.00	0.1
18 Sulphate	mg/liter	20.00	21.60	25.00	16.60	400
19 Sulfide, H2S	mg/liter	0.00	0.00	0.00	0.00	0.1
20 Copper	mg/liter	0.00	0.00	0.00	0.00	1
21 Lead	mg/liter	0.00	0.00	0.00	0.00	0.1
b. Organic Chemistry						
1 Aldrin and Dieldrin	mg/liter	0.00	0.00	0.00	0.00	0.017
2 Chlordane	mg/liter	0.00	0.00	0.00	0.00	0.003
3 DDT	mg/liter	0.00	0.00	0.00	0.00	0.042
4 Endrine	mg/liter	0.00	0.00	0.00	0.00	0.001
5 Fenol	mg/liter	0.00	0.00	0.00	0.00	0.001
6 Heptachlor and Heptachlor Epoxide	mg/liter	-	-	-	-	0.018
7 Carbon Cloroform Ektract	mg/liter	-	-	-	-	0.5
8 Lindane	mg/liter	0.00	0.00	0.00	0.00	0.056
9 Methoxychlor	mg/liter	-	-	-	-	0.035
10 Oil and Fat	mg/liter	0.00	0.00	0.00	0.00	Nil
11 Organofosphate and Carbomate	mg/liter	0.00	0.00	0.00	0.00	0.1
12 PCB	mg/liter	-	-	-	-	Nil
13 Senyawa atife biru (Sulfaktan)	mg/liter	0.00	0.00	0.00	0.00	0.5
14 Toxaphene	mg/liter	0.00	0.00	0.00	0.00	0.005
III MICRO BIOLOGY						
1 Coliform tinja	per 100 ml	2,600	7,900	18,000	14,000	2,000
2 Total Coliform	per 100 ml	9,400	17,000	28,000	24,000	10,000

NOTE:
* = The water level shall be more than or equal to 6.
mg = miligram
ml = Milimeter
Bq = Bequerel

Heavy metals are classified into dissolved matter.

Source : JICA's Water Quality Test

Table 7.1 Summary of Construction Cost in Ntonggu II Project

Scheme : Ntonggu II

Item	Amount (Rp. million)
I. Direct Construction Cost	
1.1 Preparatory Works	294
1.2 Embung Construction	
1) Main dam	2,471
2) Spillway	2,428
3) Diversion Tunnel	0
4) Seepage protection works	0
5) Miscellaneous	490
Sub-total of 1.2	5,389
1.3 Irrigation Facilities	425
1.4 Domestic Water Supply	0
1.5 Embung Operation and Maintenance Road	57
Sub-total of I.	6,165
II. Administration Cost	308
III. Engineering Services	925
Sub-total of I, II & III	7,397
IV. Physical Contingency	1,110
Sub-total of I, II, II, & IV	8,507
V. Contract Tax	820
VI. Land Acquisition Cost	31
Sub-total I, II, III, IV, V & VI	9,358
VII. Price Contingency	1,872
GRAND TOTAL	11,229

Table 7.2 Direct Construction Cost in Ntonggu II Project (1/2)

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
I. Dam				
1. Main Dam				
1.1 Earth/stone works				
1) Clearing	m2	400	21,200	8,480
2) Excavation, common	m3	3,500	26,700	93,450
, weathered rock	m3	7,500	2,100	15,750
, rock	m3	11,500	900	10,350
3) Embankment, impervious soil	m3	8,000	239,700	1,917,600
, filter	m3	12,000	12,500	150,000
, transition	m3	12,000	0	0
, random material	m3	6,000	0	0
4) Stone masonry	m3	80,000	0	0
5) Rip-rap protection	m3	15,000	10,500	157,500
1.2 Grouting	m	71,000	0	0
1.3 Other miscellaneous works				117,657
Sub-total of 1.				2,470,787
2. Spillway				
2.1 Earth works				
1) Clearing	m2	400	12,400	4,960
2) Excavation, common soil	m3	3,500	37,200	130,200
, weathered rock	m3	7,500	24,800	186,000
, rock	m3	11,500	20,700	238,050
3) Backfill	m3	5,200	2,900	15,080
2.2 Concrete works				
1) Concrete - A	m3	250,000	340	85,000
2) Concrete - B	m3	170,000	6,540	1,111,800
3) Reinforcement bar	ton	1,500,000	17	25,500
4) Form	m2	15,000	34,400	516,000
2.3 Other miscellaneous works	L.S			115,630
Sub-total of 2.				2,428,220
3. Miscellaneous & Others				489,901
Total - I.				5,388,907
II. Irrigation Facilities				
1. Canal works (including the rehabilitation works)				
1.1 Earth works				
1) Clearing	m2	400	33,200	13,280
2) Excavation	m3	5,000	3,300	16,500
3) Embankment	m3	6,300	4,900	30,870
1.2 Stone masonry	m3	80,000	3,200	256,000
Sub-total of 1.				316,650

Table 7.2 Direct Construction Cost (2/2)

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
2. Related structures				
2.1 Turnout	nos.	2,540,000	2	5,080
2.2 Syphon	nos.	5,500,000	1	5,500
2.3 Aqueduct		5,975,000	1	5,975
2.3 Cross drain	nos.	4,700,000	1	4,700
2.4 Irrigation division box	nos.	900,000	54	48,600
2.5 Division box for livestock		1,170,000	14	
Sub-total of 2.				69,855
3. Miscellaneous & Others	L.S			38,651
Total - II				425,156
III. Dam Operation and Maintenance Road				
1. Road Works				
1.1 Earth works				
1) Clearing	m2	400	9,000	3,600
2) Excavation	m3	5,000	1,300	6,500
3) Embankment	m3	6,300	3,800	23,940
4) Pavement (lime stone)	m3	15,000	1,200	18,000
2. Related structures				
2.1 Cross drain	nos.	4,700,000	0	0
3. Miscellaneous and others	L.S			5,204
Total - III				57,244
GRAND TOTAL				5,871,306

Table 8.1 Economic Construction Costs and Annual Disburement Schedule

Ntonggu II Project (Unit : Rp. million)

Item	SCF	Total cost	1st year	2nd year	3rd year
1 Direct Construction Cost		4,029	105	1,669	2,255
1) Preparatory Works	0.71	209	105	104	0
2) Dam Construction					
- Main dam	0.71	1,754	0	877	877
- Spillway	0.71	1,724	0	517	1,207
- Diversion tunnel	0.71	0	0	0	0
- Seepage protection works	0.71	0	0	0	0
Sub-total		3,478	0	1,394	2,084
3) Irrigation Facilities	0.71	302	0	151	151
4) Domestic Water Supply System	0.71	0	0	0	0
5) Dam O & M Road	0.71	40	0	20	20
2 Administration Cost	0.90	277	7	115	155
3 Engineering Services	0.90	383	153	115	115
4 Physical Contingency		598	16	247	335
Total		5,287	281	2,146	2,860

Note : Standard Conversion Factors (SFC). Source ; Pedoman Pengamatan dan Evaluasi Proyek-Proyek Pengairan, Direktorato Jeneral Pengairan, 1985

Table 8.2 Financial and Economic Prices of Farm Inputs and Outputs in NTB

	Item		Unit	Lombok		Sumbawa	
				Financial Price *1	Economic Price *2	Financial Price *1	Economic Price *2
1	Farm Products						
	Paddy *3		kg	280	397	260	394
	Maize *3		kg	200	220	200	215
	Mungbeans *3		kg	1,000	906	1,000	901
	Soybeans *3		kg	900	647	900	642
	Red onion *4		kg	900	704	800	699
	Tobacco *5		kg	900	522	900	521
2	Seeds						
	Paddy	Certified	kg	605	605	605	605
		Own	kg	-	325	-	325
	Maize	Certified	kg	922	922	922	922
		Own	kg	-	297	-	297
	Mungbeans	Certified	kg	1,383	1,383	1,383	1,383
		Own	kg	-	893	-	893
	Soybeans	Certified	kg	617	617	617	617
		Own	kg	-	606	-	606
	Red onion		kg	850	850	850	850
	Tobacco		kg	25,000	25,000	25,000	25,000
3	Fertilisers						
	Urea		kg	350	414	350	419
	TSP		kg	400	486	400	491
	KCl		kg	400	416	400	421
4	Agro-chemicals						
	Insecticides	Liquid type	lit	10,000	10,000	10,000	10,000
		Powder type	kg	3,000	3,000	3,000	3,000
	Rodenticides		kg	5,500	5,500	5,500	5,500
5	Labour						
	Hired labour *6		man-day	3,000	2,250	2,500	1,875
	Family labour		man-day	-	2,250	-	1,875
6	Draft Animal						
	Hired		head-day	6,000	6,000	5,000	5,000
	Own		head-day	-	6,000	-	5,000
7	Farm Machinery						
	Tractor		ha	250,000	250,000	200,000	200,000

Remarks : *1 ; As of 1994

*2 ; Projected prices in 2005 at 1994 constant prices

*3 ; Dry grain

*4 ; Fresh

*5 ; Fresh leaves

*6 ; Economic conversionfactor is 0.75.

Table 8.3 Economic Crop Budget per Ha

Ntonggu II Project

Item		Q'ty of Unit	Value (Rp.)	Without Project: Paddy (Irrigated) Q'ty	Am't (Rp.)	Paddy (Rainfed) Q'ty	Am't (Rp.)	Soybean (2nd crop) (Rainfed) Q'ty	Am't (Rp.)	With Project: Paddy (Irrigated) Q'ty	Am't (Rp.)	Mungbean (Irrigated) Q'ty	Am't (Rp.)	Mungbean (Rainfed) Q'ty	Am't (Rp.)
1 Gross Production Value															
Paddy		kg	394	3,000	1,182,000	2,000	788,000	0	0	4,500	1,773,000	0	0	0	0
Soybean		kg	642	0	0	0	0	600	385,200	0	0	0	0	0	0
Mungbean		kg	901	0	0	0	0	0	0	0	0	1,200	1,081,200	950	855,950
Red onion		kg	699	0	0	0	0	0	0	0	0	0	0	0	0
2 Production Cost															
Seed															
Paddy	Certified	kg	605	50	30,250	0	0	0	0	25	15,125	0	0	0	0
	Own	kg	325	0	0	50	16,250	0	0	0	0	0	0	0	0
Soybean	Certified	kg	617	0	0	0	0	10	6,170	0	0	0	0	0	0
	Own	kg	606	0	0	0	0	30	18,180	0	0	0	0	0	0
Mungbean	Certified	kg	1,383	0	0	0	0	0	0	0	0	10	13,830	10	13,830
	Own	kg	893	0	0	0	0	0	0	0	0	20	17,860	20	17,860
Red onion	Certified	kg	850	0	0	0	0	0	0	0	0	0	0	0	0
Fertiliser															
Urea		kg	419	225	94,275	150	62,850	20	8,380	300	125,700	75	31,425	60	25,140
TSP		kg	491	75	36,825	50	24,550	40	19,640	100	49,100	100	49,100	80	39,280
KCl		kg	421	35	14,735	0	0	20	8,420	50	21,050	50	21,050	40	16,840
Agro-chemicals															
Insecticide	Lquid	lit	10,000	2.0	20,000	0.5	5,000	0.0	0	2.0	20,000	2.0	20,000	2.0	20,000
	Powder	kg	3,000	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Rodenticide		kg	5,500	2.0	11,000	0.5	2,750	0.0	0	2.0	11,000	1.0	5,500	1.0	5,500
Labor															
Family		md	1,875	127	238,125	65	121,875	20	37,500	172	322,500	80	150,000	80	150,000
Hired		md	1,875	13	24,375	10	18,750	0	0	13	24,375	0	0	0	0
Draft Animal															
Family		ad	5,000	20	100,000	10	50,000	0	0	20	100,000	10	50,000	10	50,000
Hired		ad	5,000	0	0	0	0	0	0	0	0	0	0	0	0
Tractor		ha	200,000	0	0	0	0	0	0	0	0	0	0	0	0
Total production cost					569,585		302,025		98,290		688,850		358,765		338,450
3 Net Production Value					612,415		485,975		286,910		1,084,150		722,435		517,500

Table 8.4 Economic Costs and Benefits Flow

Ntonggu II Project Unit : Million Rp.

Year	Cost				Benefit			Increment
	Capital	Replace	O&M	Total	Irrigation	Negative	Total	
1.	281	0	0	281	0	-14	-14	-295
2.	2,146	0	0	2,146	0	-14	-14	-2,160
3.	2,860	0	0	2,860	0	-14	-14	-2,874
4.	0	0	21	21	122	-6	116	95
5.	0	0	21	21	143	-4	139	118
6.	0	0	21	21	163	-3	160	139
7.	0	0	21	21	184	-1	183	162
8.	0	0	21	21	204	0	204	183
9.	0	0	21	21	204	0	204	183
10.	0	0	21	21	204	0	204	183
11.	0	0	21	21	204	0	204	183
12.	0	0	21	21	204	0	204	183
13.	0	0	21	21	204	0	204	183
14.	0	0	21	21	204	0	204	183
15.	0	0	21	21	204	0	204	183
16.	0	0	21	21	204	0	204	183
17.	0	0	21	21	204	0	204	183
18.	0	0	21	21	204	0	204	183
19.	0	0	21	21	204	0	204	183
20.	0	0	21	21	204	0	204	183
21.	0	0	21	21	204	0	204	183
22.	0	0	21	21	204	0	204	183
23.	0	0	21	21	204	0	204	183
24.	0	0	21	21	204	0	204	183
25.	0	0	21	21	204	0	204	183
26.	0	0	21	21	204	0	204	183
27.	0	0	21	21	204	0	204	183
28.	0	0	21	21	204	0	204	183

EIRR = #NUM! %

Table 8.5 Financial Crop Budget per Ha

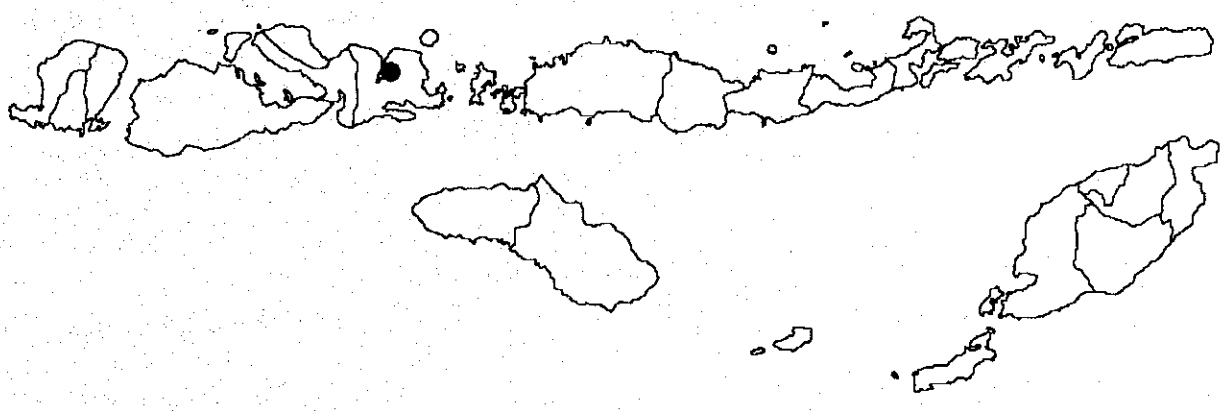
Ntonggu II Project

Item		Q'ty of Unit	Value (Rp.)	Without Project: Paddy (Irrigated) Q'ty	Paddy (Irrigated) Am't (Rp.)	Paddy (Rainfed) Q'ty	Paddy (Rainfed) Am't (Rp.)	Soybean (2nd crop) (Rainfed) Q'ty	Soybean (2nd crop) (Rainfed) Am't (Rp.)	With Project: Paddy (Irrigated) Q'ty	Paddy (Irrigated) Am't (Rp.)	Mungbean (Irrigated) Q'ty	Mungbean (Irrigated) Am't (Rp.)	Mungbean (Rainfed) Q'ty	Mungbean (Rainfed) Am't (Rp.)
1 Gross Production Value															
Paddy		kg	260	3,000	780,000	2,000	520,000	0	0	4,500	1,170,000	0	0	0	0
Soybean		kg	900	0	0	0	0	600	540,000	0	0	0	0	0	0
Mungbean		kg	1,000	0	0	0	0	0	0	0	0	1,200	1,200,000	950	950,000
Red onion		kg	800	0	0	0	0	0	0	0	0	0	0	0	0
2 Production Cost															
Seed															
Paddy	Certified	kg	605	50	30,250	0	0	0	0	25	15,125	0	0	0	0
	Own	kg	0	0	0	50	0	0	0	0	0	0	0	0	0
Soybean	Certified	kg	617	0	0	0	0	10	6,170	0	0	0	0	0	0
	Own	kg	0	0	0	0	0	30	0	0	0	0	0	0	0
Mungbean	Certified	kg	1,383	0	0	0	0	0	0	0	0	10	13,830	10	13,830
	Own	kg	0	0	0	0	0	0	0	0	0	20	0	20	0
Red onion	Certified	kg	850	0	0	0	0	0	0	0	0	0	0	0	0
Fertiliser															
Urea		kg	350	225	78,750	150	52,500	20	7,000	300	105,000	75	26,250	60	21,000
TSP		kg	400	75	30,000	50	20,000	40	16,000	100	40,000	100	40,000	80	32,000
KCl		kg	400	35	14,000	0	0	20	8,000	50	20,000	50	20,000	40	16,000
Agro-chemicals															
Insecticide	Lquid	lit	10,000	2.0	20,000	0.5	5,000	0.0	0	2.0	20,000	2.0	20,000	2.0	20,000
	Powder	kg	3,000	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Rodenticide		kg	5,500	2.0	11,000	0.5	2,750	0.0	0	2.0	11,000	1.0	5,500	1.0	5,500
Labor															
Family		md	0	127	0	65	0	20	0	172	0	80	0	80	0
Hired		md	2,500	13	32,500	10	25,000	0	0	13	32,500	0	0	0	0
Draft Animal															
Family		ad	0	20	0	10	0	0	0	20	0	10	0	10	0
Hired		ad	5,000	0	0	0	0	0	0	0	0	0	0	0	0
Tractor		ha	200,000	0	0	0	0	0	0	0	0	0	0	0	0
Total production cost					216,500		105,250		37,170		243,625		125,580		108,330
3 Net Production Value					563,500		414,750		502,830		926,375		1,074,420		841,670

The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Ntonggu II Embung Development Project

Figures



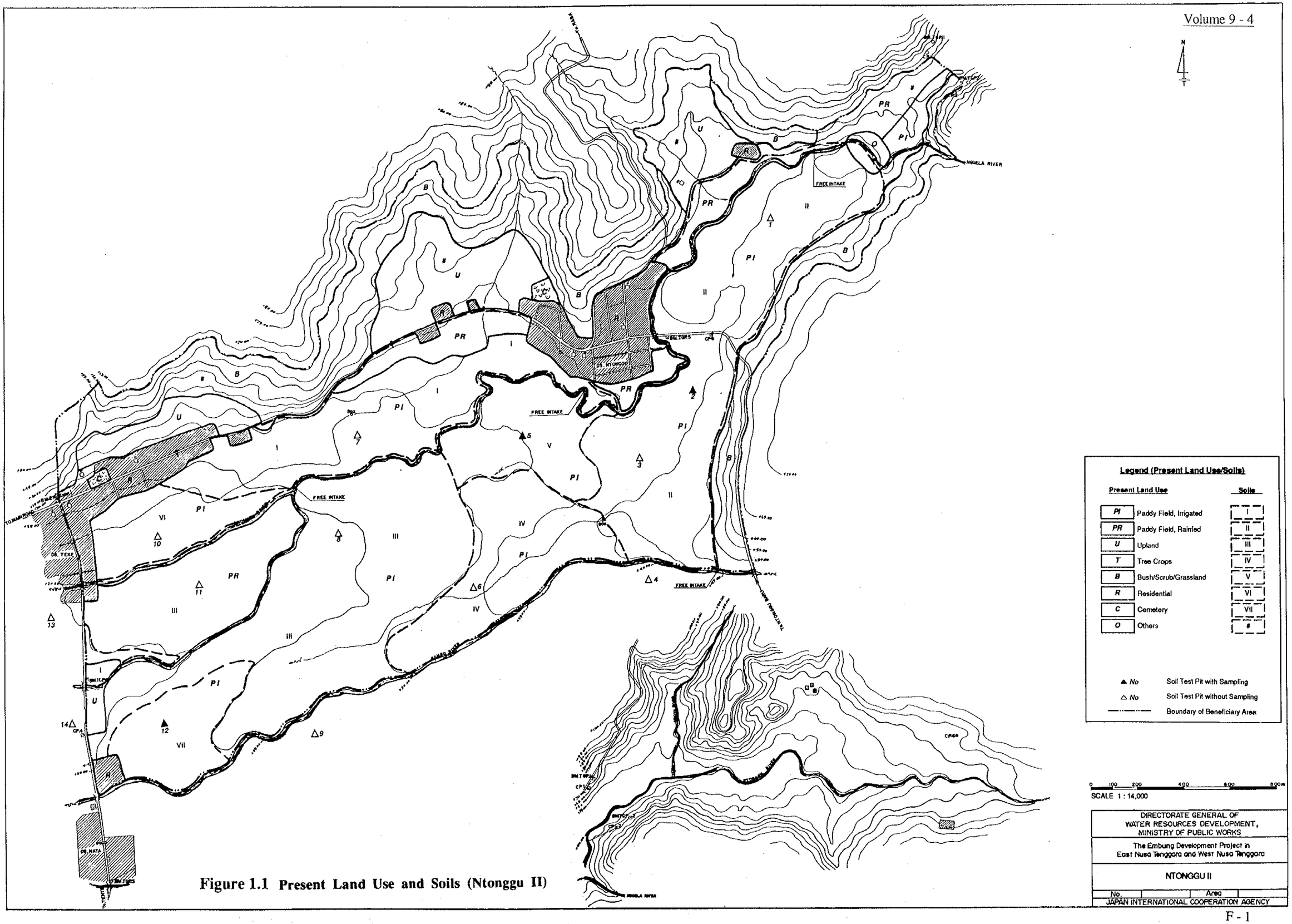


Figure 1.1 Present Land Use and Soils (Ntonggu II)

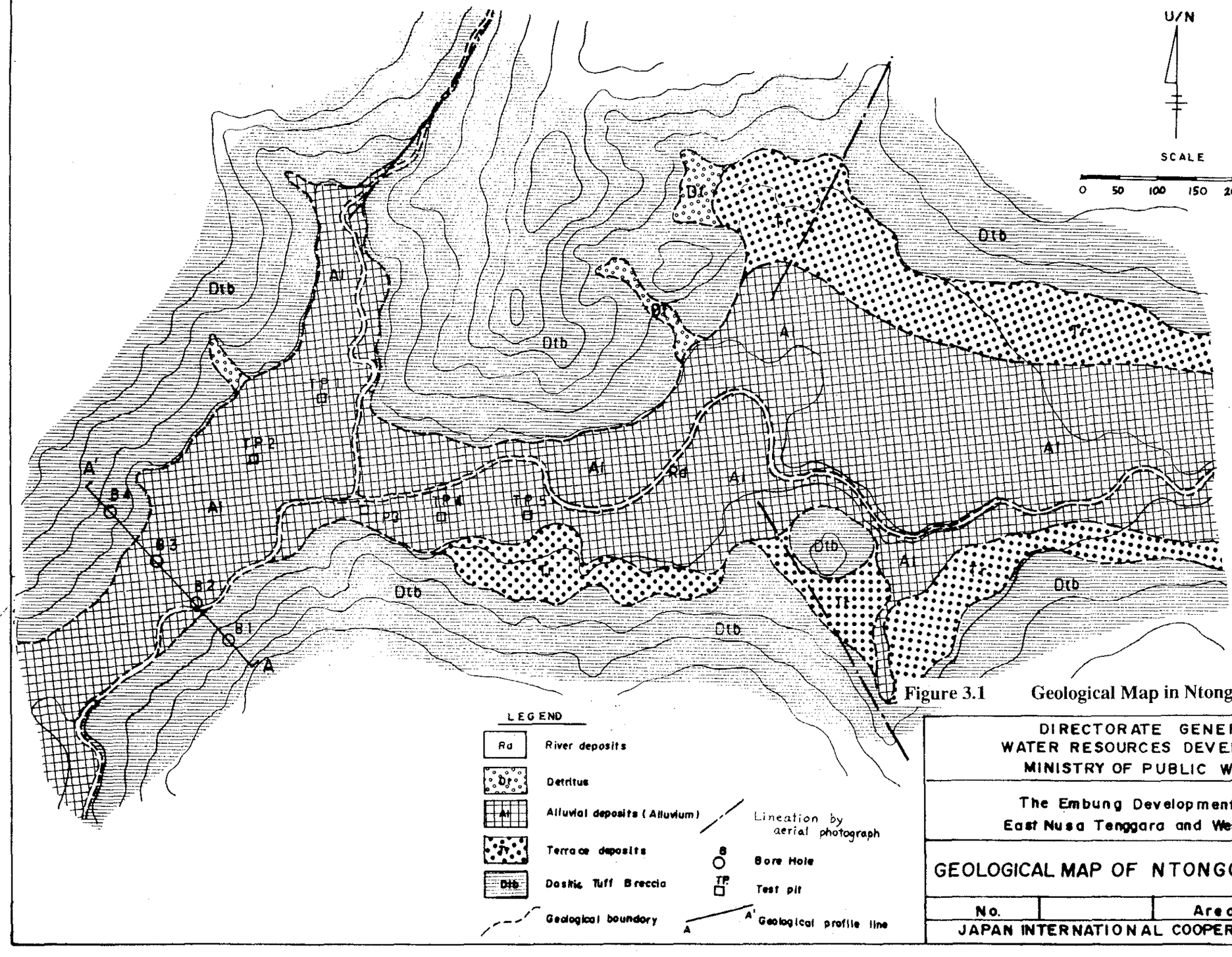


Figure 3.1 Geological Map in Ntonggu II Embung Site

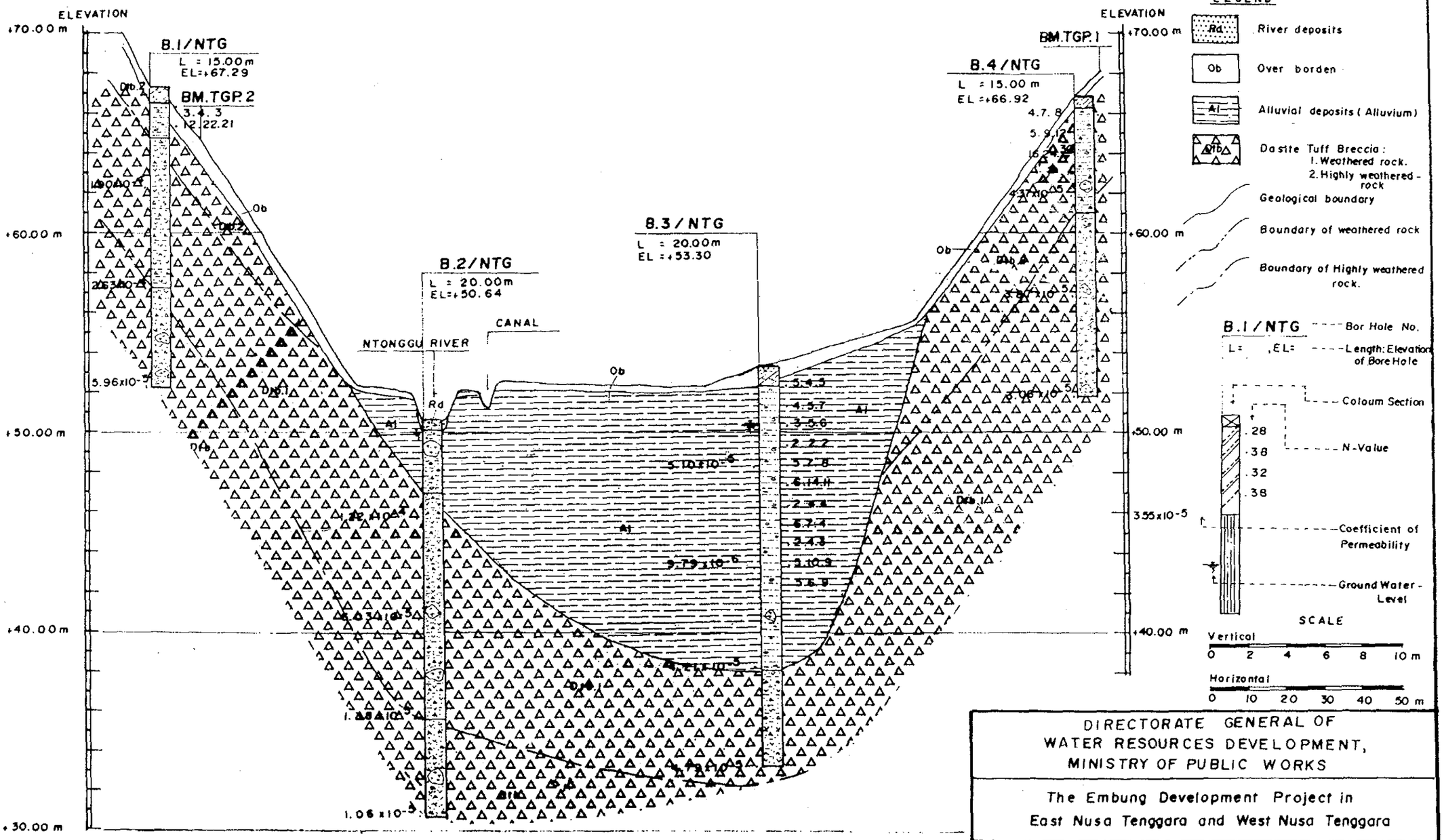
DIRECTORATE GENERAL OF
WATER RESOURCES DEVELOPMENT,
MINISTRY OF PUBLIC WORKS

The Embung Development Project in
East Nusa Tenggara and West Nusa Tenggara

GEOLOGICAL MAP OF NTONGGU.II. SITE

No.		Area	

JAPAN INTERNATIONAL COOPERATION AGENCY



DIRECTORATE GENERAL OF
WATER RESOURCES DEVELOPMENT,
MINISTRY OF PUBLIC WORKS

The Embung Development Project in
East Nusa Tenggara and West Nusa Tenggara

GEOLOGICAL PROFILE OF NTONGGU.II. SITE

No.		Area	

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 3.2 Geological Profile in Ntonggu II Embung Site

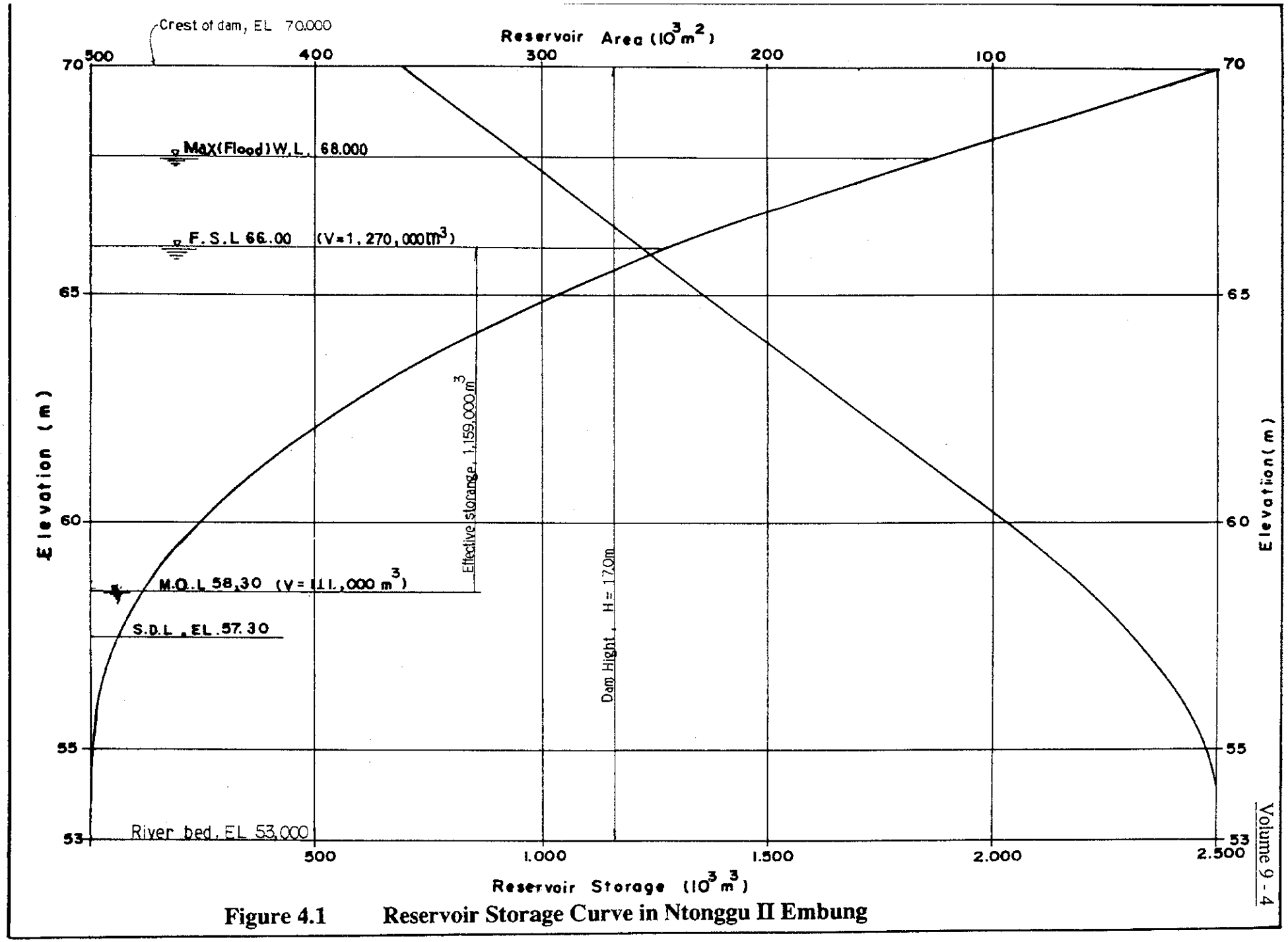


Figure 4.1 **Reservoir Storage Curve in Ntonggu II Embung**

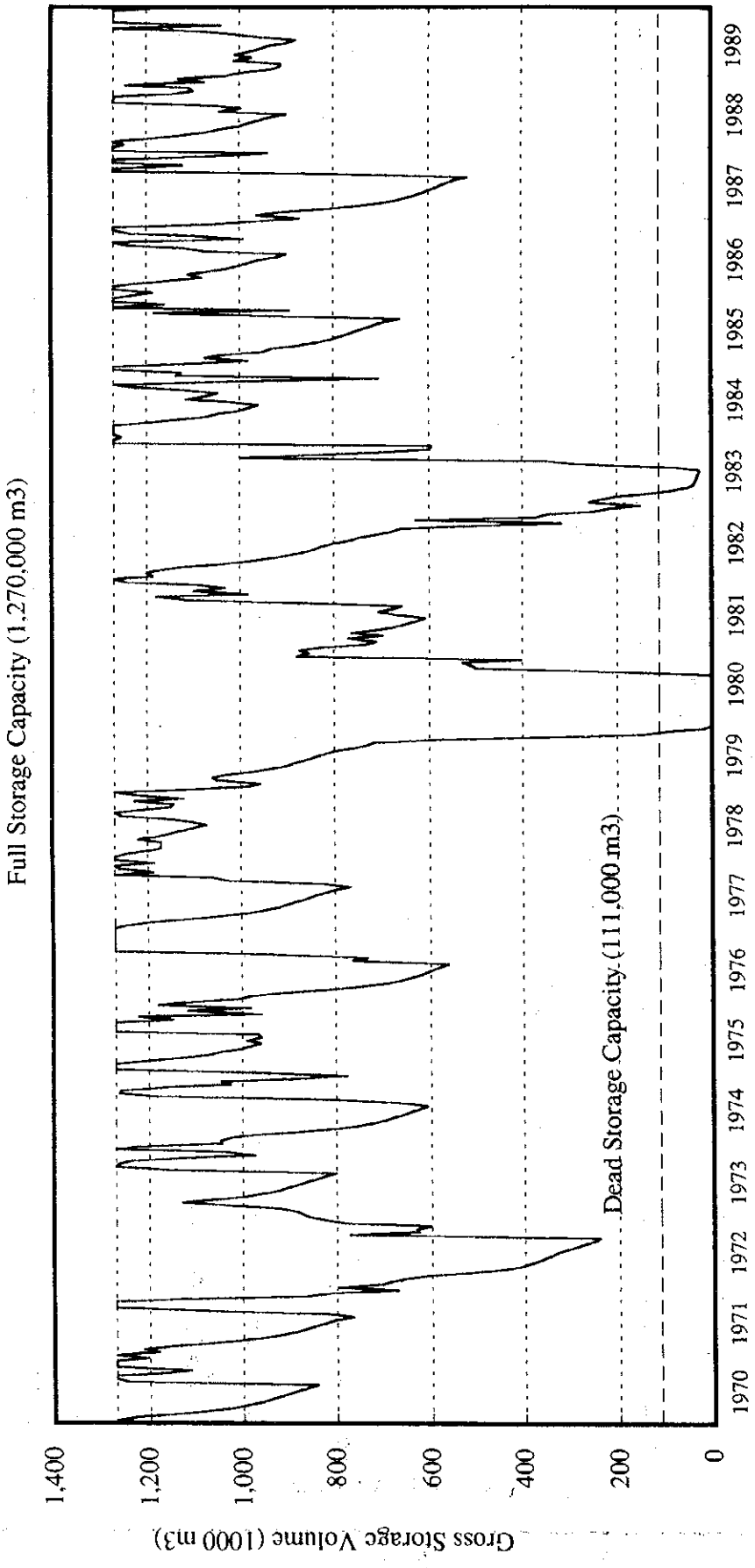


Figure 4.2 Result of Reservoir Operation in Ntonggu II Embung

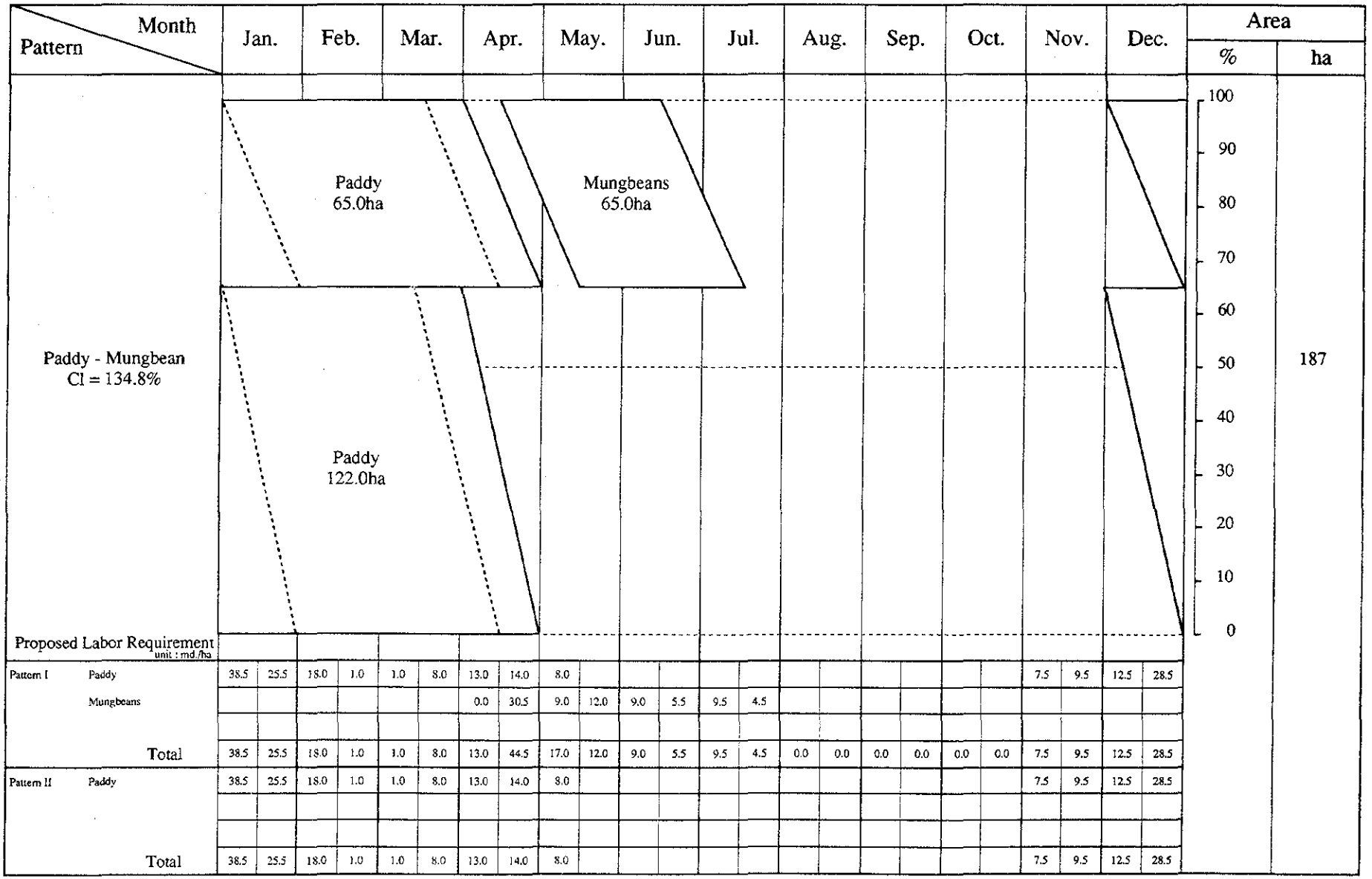
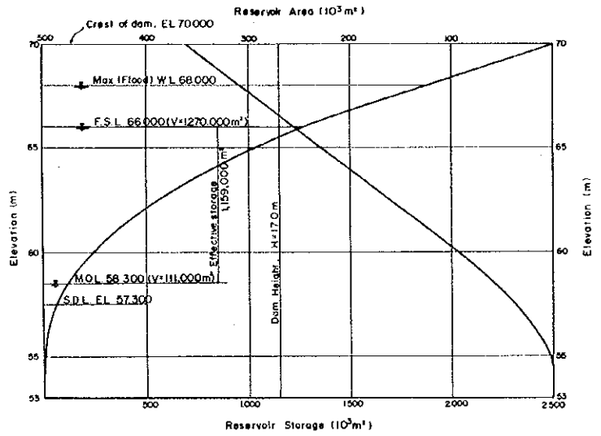
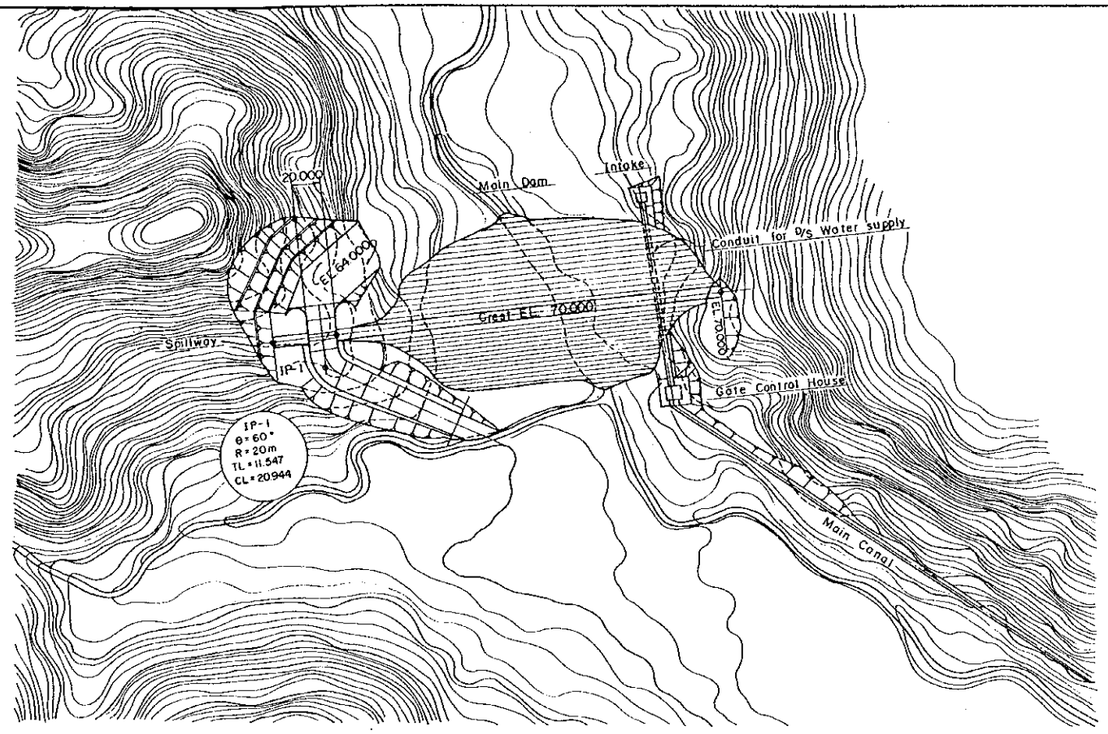


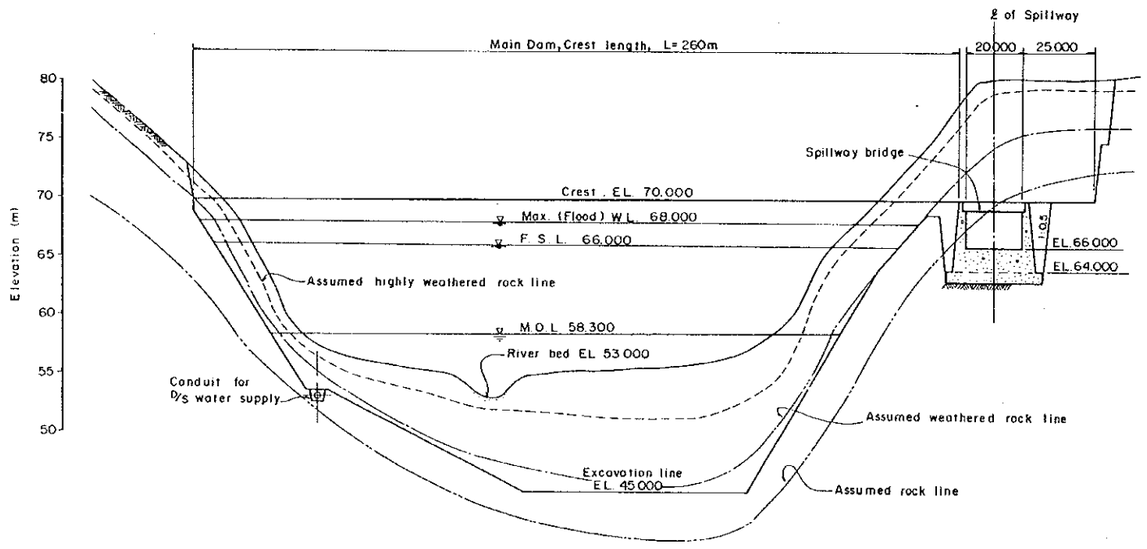
Figure 4.3 Proposed Cropping Pattern for Ntonggu II Project



RESERVOIR STORAGE CURVE AT NTONGGU-II

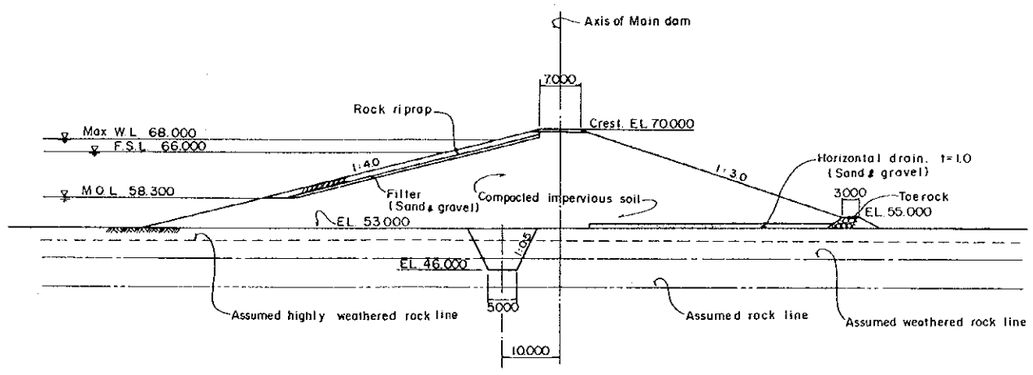


PLAN Scale A



PROFILE OF MAIN DAM

Scale : H=1:1000
V=1:250



TYPICAL SECTION OF MAIN DAM

Scale B

Scale A 0 50 100 150 200m

Scale B 0 10 20 30 40 50m

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT, MINISTRY OF PUBLIC WORKS	
The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara	
GENERAL PLAN OF NTONGGU-II EMBUNG	
No.	Area
JAPAN INTERNATIONAL COOPERATION AGENCY	

Figure 4.4 General Plan of Ntonggu II Embung